U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.

IN COOPERATION WITH THE NEW YORK STATE COLLEGE OF AGRICULTURE,
CORNELL UNIVERSITY.

SOIL SURVEY OF TOMPKINS COUNTY, NEW YORK.

BY

FRANK B. HOWE, IN CHARGE, AND H. O. BUCKMAN, OF THE NEW YORK STATE COLLEGE OF AGRICULTURE, AND H. G. LEWIS, OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Advance Sheets—Field Operations of the Bureau of Soils, 1920.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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SOIL SURVEY OF TOMPKINS COUNTY, NEW YORK.

By FRANK B. HOWE, in Charge, and H. O. BUCKMAN, of the New York State College of Agriculture, and H. G. LEWIS, of the United States Department of Agriculture.

DESCRIPTION OF THE AREA.

Tompkins County is situated near the central part of New York in what is known as the Finger Lakes region. It is rectangular in shape, its dimensions being approximately 24 miles from north to south and 23 miles from east to west, and comprises a total land surface of 476 square miles, or 304,640 acres.

Tompkins County lies entirely within the area of the Allegheny Plateau, which constitutes an elevated region skirting the west side of the great Appalachian Valley from its south to its north end.

The southern part of Tompkins County consists of a high plateau rising to about 1,900 feet above sea level, dissected by a series of broad valleys with generally straight courses, with smooth, gentle lower slopes and relatively steep upper slopes, with few tributaries other than narrow ravines, and with rolling valley bottoms. The remnants of the plateau still intact are small in area and have a strongly rolling surface.

FIG. 46.—Sketch map showing location of the Tompkins County area, New York.

The northern part of the county, that part lying north of an escarpment running in a very irregular course across the county immediately south of Ithaca, consists of the full width of one and part of two other north-south ridges, separated by the deep valleys in which Cayuga and Owasco Lakes lie, including their north and south continuation beyond the lakes. The three ridges are remnants of an ancient plateau that stretched northward from the foot of the higher plateau in the southern part of the county. The former plateau lies about 500 feet lower than the latter along its southern border. The ridges forming it are broad and smooth, with very little dissection except that of the two deep valleys already mentioned and a few shallower valleys of the same type but less depth, such as that occupied by Salmon Creek. The rest of the dissection consists of mere surface scratches, except the narrow gorges that have been cut by the small streams flowing into the lakes in the side slopes of the ridges for a short distance back from the lakes. While these ridges are remnants of a plateau, they are not plateaulike in their broad features. They have a narrow longitudinal central axis of maximum elevation. From this axis the surface slopes toward the broad lake-filled valleys in a moderately gentle but well-defined sweeping slope to within less than a mile of the lake and in many cases less than half a mile, where the slope

rapidly but still smoothly steepens, and finally, in the last hundred feet or more above the surface of the lake, or the bottom of the valley when no lake occurs, becomes almost precipitous.

All these broad valleys, both those in the northern as well as those in the southern plateau, are partly filled in places with accumulations of unconsolidated sands, gravels, and clays, some with smooth surfaces, others with very rough surfaces. They consist of both glacial or ice-laid and of water-laid accumulations. There is a thin coating of glacial drift spread over the upland of the county. The drainage system of the county is relatively simple. Its details are shown on the map.

The attention of the settler was first drawn to this part of New York State through the expedition under General Sullivan in 1778–79. A part of Sullivan's force camped near Ithaca, and upon their return the soldiers of this force carried back descriptions of the central New York region. At this time Tompkins County, with the exception of a few fields cultivated by the Indians, was covered with a heavy forest.

The first white settlers in Tompkins County consisted of a group of 11 men who left Kingston, N. Y., in 1788. In 1789 three members of this group finally settled upon a lot of 400 acres located within the present site of Ithaca. Upon this tract clearings were found from which the hazel and thorn bushes had been removed by the Indians, and which had been cultivated by them. These clearings were at oncd put under cultivation and corn was planted. The following yeae these men brought their families and household effects from the Eastr

They also brought livestock, including hogs, sheep, cattle, and horses. Many other settlements in various parts of the county were made between 1788 and 1800.

The lands of this region were ceded to the State of New York in 1789 by the Iroquois, and a part of the territory known as the "military tract" was soon opened to settlement. This tract was laid out in townships of 640 acres each containing 100 lots. All of Tompkins County except the three southern townships were included in this military tract. Tompkins County was formed from portions of Cayuga and Seneca Counties on April 17, 1817, changes in boundary being made at subsequent dates, the last in 1853. Records available show that the population in 1840 was 34,299.[1] From that time to the present there has been a decline in population, with the exception of the town of Ithaca, though of course there have been periods of temporary increases. The census for 1920 gives the population of the county as 35,285. Especially significant are the census figures for the urban and rural population. According to the Federal census for the year 1880, the urban population of Tompkins County was only 9,105, while the rural population was 25,340. Forty years later, the records show an urban population of 17,004 and a rural population of only 18,281. This state of relative decrease in rural population has continued up to the present time. In 1920, only 51.8 per cent of the total population of Tompkins County was rural.

The present rural population consists largely of the descendants of the original settlers. Foreign-born whites constituted only 7.5 per cent of the total population in 1920.

[1] History of Tioga, Chemung, and Tompkins Counties. By Pierce and Hurd.

The largest city in the county is Ithaca, with a population of 17,004. The county seat is located at Ithaca. Cornell University, which includes the New York State College of Agriculture and New York State Veterinary College, is situated at this place. The other principal villages, with their populations, are; Groton, 2,235; Trumansburg, 1,011; Dryden, 707; Freeville, 303; Newfield, 302; and Cayuga Heights, 179.

The present transportation facilities of the county are supplied by the Delaware, Lackawanna & Western and the Lehigh Valley Railroads, together with the Central New York Southern running from Ithaca to Auburn, N. Y. All the railroads in the county have direct connection with Ithaca.

CLIMATE.

The climatic conditions of Tompkins County are typical of central and western New York, although the range of temperature is somewhat less than in other parts of the region. The snowfall is also said to be lighter than in the surrounding counties.

Study of the records kept at Ithaca, covering a period of 40 years, shows a wide range in temperature between the winter and summer months. The winter season is usually from four to five months in duration, and generally there are short periods of extreme cold. Very often mild temperatures prevail for considerable periods during the winter months. The records at Ithaca show an absolute minimum of −22° F. and an absolute maximum of 70° F. for the winter months, a range of 92° F. The mean temperature of this season is about 26.1° F. The absolute minimum temperature for the summer months is 36° F. and the absolute maximum 102° F. giving a temperature range of 66° F. The records show a mean temperature for the summer months of 68.3° F. Owing to the great differences in elevation, the season in many parts of the county is shorter and cooler than at Ithaca.

The precipitation is fairly well distributed throughout the year, though periods of excess and drought often occur. The greater proportion of rainfall comes during June, July, and August. The least precipitation occurs during December, January, and February. The precipitation varies considerably from year to year, the amount for the wettest year being about 12 inches above and the amount for the driest year about 13 inches below the annual mean. This mean is 34.28 inches.

For the growing season, May 1 to October 1, inclusive, the total mean precipitation is 17.13 inches, or about one-half of the total precipitation for the average year. The total precipitation for the period May 1 to October 1, inclusive, in the driest year (1879) was 13.33 inches, or 3.80 less than the total mean precipitation for the same period.

The average length of the period in which immunity from killing frost can be expected is 157 days. The earliest frost in the fall of which there is a record occurred September 11 and the latest in spring June 9. The grazing season for dairy cattle generally is from three to four weeks longer than the actual frost-free season.

The following table, compiled from the records of the Weather Bureau station at Ithaca, gives a detailed statement of the more essential climatic features:

Normal monthly, seasonal, and annual temperature and precipitation at Ithaca.

(Elevation, 928 feet.)

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1879).	Total amount for the wettest year (1890).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	28.4	65	−22	2.64	1.42	3.47
January	24.1	70	−20	2.16	.75	2.68
February	25.7	62	−18	1.87	.82	2.17
Winter	26.1	70	−22	6.67	2.99	8.32
March	31.9	82	−14	2.44	1.05	3.82
April	44.2	89	13	2.29	1.83	3.34
May	57.0	96	22	3.43	4.81	6.60
Spring	44.4	96	−14	8.16	7.69	13.76
June	66.2	96	36	3.88	2.80	4.94
July	70.6	102	40	3.75	4.05	1.24
August	68.2	101	39	3.24	.73	4.92
Summer	68.3	102	36	10.87	7.58	11.10
September	60.6	96	29	2.83	.94	6.62
October	49.5	87	17	3.17	.31	4.66
November	37.6	75	−1	2.58	1.69	1.93
Fall	49.2	96	−1	8.58	2.94	13.21
Year	46.9	102	−22	34.28	21.20	46.39

AGRICULTURE.

The pioneers of this region found vast forests of white pine, which covered all the hillsides and valleys. "About Ithaca," once wrote Governor Clinton, "there is more pine than in any other portion of the western country." Nearly all the varieties of forest trees, both "hard" and "soft," that are common to the latitude were found in the vicinity.

Before the advent of the white settlers in this region the Indians grew corn, vegetables, and fruits. The land selected for such purposes by the Indians was usually on the flats or recent alluvial soils, where little difficulty in clearing the land was encountered. It is related that the Indians cleared a portion of the flat on which the city of Ithaca stands and were successful in growing corn and vegetables. Also the delta of Taghanic Creek in Cayuga Lake was cultivated by the Indians. Considerable numbers of fruit trees are reported to have been found here by the early settlers. It appears that this Indian settlement at the mouth of Taghanic Creek was missed by General Sullivan's party and consequently spared. There were undoubtedly many other places similarly located along Cayuga Lake that Indians utilized for growing corn and vegetables, but apparently no considerable areas within Tompkins County were cultivated by the Indians. The region was primarily a hunting ground and a fishing place, and only a few summer settlements at advantageous places along Cayuga Lake were used to grow crops. The Indians were accustomed to barter and transport grain and other food materials from the regions to the north and west. An idea of the Indian agriculture of the Genesee country is obtained from a report of Sullivan's

expedition. It is reported that the soldiers found corn fields producing crops exceeding in quality and quantity anything to which they had been accustomed in their eastern homes. The reports the soldiers of Sullivan's expedition carried home with them of the wonderful fertility and bountiful crops found in the western country created a desire in the minds of many adventurous persons to seek out a home for themselves amid such a land of plenty. This fact, together with the granting of tracts to soldiers of the Revolutionary War as a reward for their services, had a great influence on the settlement of Tompkins County.

The first efforts of the settlers were naturally directed toward clearing the land and growing subsistence crops. The first settlements were made in the valleys on the alluvial soils. Many of the trails and roads followed the valley routes. Water for domestic purposes and for generating power was available at these places. Settlements were made at favorable sites along the valleys, and from these points as a nucleus agricultural operations expanded. It is related that for many years after the first settlement on the flat where Ithaca now stands it was the custom for the whole neighborhood extending several miles around to avail themselves of the clearings on the flat. Here they planted corn principally, thinking that it could not be grown upon the higher ground. Cribs were built on the hillsides in which the corn was stored after the crop matured. As many as 25 cribs are reported to have been standing on the hillside at one time. The crop of corn, together with 24 bushels of wheat procured at a settlement upon the Upper Nanticoke and floured at the nearest mill, at Wilkes-Barre, Pa., constituted the only supply of grain for the three original families on the flat for one year. To provide potatoes for the following season a member of one of the families traveled on foot 160 miles to a point on the Delaware, where he obtained three pecks of potato eyes or sprouts and returned, carrying them in a sack upon his shoulders. The first attempt to raise wheat in Tompkins County was made in 1788 or 1790. In 1788 it is related that a party headed by Jonathan Woodworth drove in 70 head of cattle and horses, which subsisted upon hay obtained on the lake flats.

Wheat was one of the first crops to be grown extensively. Lansing Town early began to be an important grain section. The soil in Lansing Town was considered to be better adapted to grain than to grass. Among the old settlers the section comprising the town of Lansing was generally called "Egypt," as they went there to buy grain until they could grow it.

Although access to outside markets was difficult and the transportation facilities slow and inefficient, shipment of products from the county was early accomplished. Wheat was forwarded by land carriage to Owego, then down the Susquehanna on "arks" to Baltimore where 50 to 60 cents a bushel was obtained for it. In 1807 some 21,000 bushels of wheat were shipped southward, and in 1808, 1809, and 1810 an average of 4,000 bushels was shipped each year. Cattle were driven to Philadelphia. Good cows were then worth $16 a head, oxen $50, and 3-year-old steers about $18. Horses were worth from $75 to $80. Oats, buckwheat, and corn were not grown for sale, and butter had not at this time been introduced into the market. The expense of carrying goods over the route via Owego to Baltimore

was $2 per 100 pounds, or if brought from New York with teams by way of Catskill the charges were $4 per 100 pounds.

In the early days of settlement considerable tobacco was grown. There were also many distilleries using the grain crops. Asheries and charcoal pits were important in the early days, accompanying the clearing of the land of timber.

The land once occupied by dense forests of pines and hardwoods was found to be very productive, and especially well suited to grains. Grasses, mostly timothy and bluegrass, soon came in on the cleared areas, which furnished excellent grazing for cattle and sheep. Prior to the clearing of the land of timber, only "browse" was available, and it was customary to let out the stock to the settlers in Lansing Town until such time came that their owners could provide feed for them.

The usual procedure of the first settlers was to remove the timber and pile the brush for a time, which was commonly referred to as allowing the land to lie fallow. In the following spring the brush was burned. The soil, owing to its loose and fluffy character, was not plowed, but wheat was sown broadcast and harrowed in with a tree top.

The yields of wheat were considered good and each settler was able to grow enough for his own use and for many of his poorer neighbors. Corn and oats were grown extensively and fine crops of hay were obtained. The remarkable productivity of the soil and the increasing number of new settlers coming into the county soon increased the importance of farming. Much land was held in large tracts. With the exception of the three southern towns in the county, the land was disposed of under the military grant. Large tracts in the southern part of the county were bought by private parties for a nominal sum and later subdivided and resold. The price paid for land varied considerably, but in the year 1800 several farms were sold for an average price of $3 an acre.

Improved methods in cultivation and alternation of crops brought a profitable return for grain farming, wheat being the principal crop. The appearance of the "midge" served to curtail yields, and because of this pest the culture of wheat was almost wholly abandoned for many years. However, new varieties of grain and rotations of crops again made the production of wheat successful and the crop of 1877 was one of the best ever produced.

The possibilities of stock raising and dairying were early recognized. It is interesting to note that the raising of sheep for wool was one of the principal industries in the county in the early days. The following table exhibits for the years 1855, 1864, 1865, 1874, and 1875 the number of sheep shorn, the total weight of the clip, and the average weight of the fleeces:

Number, total weight, and average weight of fleeces in years 1855, 1864, 1865, 1874, and 1875.

Year.	Number.	Total weight.	Average weight.
1855	47,197	160,833	3.41
1864	66,859	261,620	3.91
1865	67,679	259,186	3.83
1874	27,288	126,997	4.65
1875	26,945	126,944	4.71

Sheep husbandry was an especially important industry during the Civil War, when the price of wool was high, but the raising of sheep has continually declined, until in 1920 there were only 10,561 sheep on the farms in the county. At present sheep are nearly always kept as a side line. Perhaps 30 per cent of the farms in Tompkins County have flocks of sheep which average 25 head. The chief income from sheep is derived from the sale of lambs. The majority of the sheep are Shropshire grades, with a considerable admixture of Merino blood. There are only a few purebred sheep of any kind.

Before the days of the railroads, the raising of beef cattle was an important industry and formed with the raising of grain and lumbering the chief sources of income for the early settler.

Dairying, which had been increasing in importance from the beginning, became a leading industry in the county upon the advent of railroads. The product, largely cheese, was shipped to outside markets. Dairying continues to be the main industry, although butter and cheese making have been largely displaced by the sale of milk. Most of the milk is sent to New York City, although at times a considerable quantity has been hauled to Ithaca for manufacture into milk products. Nearly every railroad station in the county has a milk depot to which farmers haul their milk daily. The importance of dairying as an industry in this county is reflected by the proportion of farm receipts derived from cattle. It is estimated that 40 per cent of the total receipts of the farms of the county come from cattle. The dairy stock are carefully housed and modern equipment is used. The Holstein is the predominating breed of dairy cattle, followed by the Jersey, Durham, Guernsey, Brown Swiss, and Ayrshire. Many herds are composed altogether or in part of purebred stock. In 1875 there were 15,518 milk cows in the county. In the same year 1,966,265 pounds of butter and 14,891 pounds of cheese were made in families, while milk sold in market totaled 140,039 gallons. In 1875 the milk of 1,503 cows was sent to factories. In 1874 there were 6 butter and cheese factories in the county, with a total production of butter for the same year of 75,847 pounds. According to the census, there were 22,390 cattle in the county in 1920, of which 21,476 were dairy cows. The total amount of milk produced in 1920 was 6,698,576 gallons. The total amount of butter produced on farms the same year was 250,031 pounds.

In 1920 there were 7,305 horses in Tompkins County, with a total valuation of $983,947. There are approximately 3 horses to a farm, with an average of 25 tillable acres per horse. There are only a few good draft stallions in the county. Good draft breeds are becoming more important.

Poultry is kept on nearly every farm. The Leghorn breeds are most popular, as it appears that egg production is the most important consideration. Egg production on the average, however, is very low, principally because improper feed and care are given to the hens. However, as a side line, poultry is profitable on the farm. The census of 1920 shows that the number of poultry of all kinds in the county amounted to 161,368, with a total value of $221,678.

The total number of hogs in Tompkins County in 1920 was 6,733, with a total value of $137,806. June 1, 1875, 14,039 hogs were reported on the farms of this county. The decrease in the number of hogs

kept on the farms is due to the inability of the Tompkins County farmer to compete with the Corn Belt in hog production.

Hay, oats, potatoes, corn, wheat, buckwheat, and apples are the leading crops. Hay is the one universal crop. It is estimated that over 50 per cent of the area devoted to crops in Tompkins County is in hay. The total value of the hay crop of the county is worth nearly as much as the value of all other crops combined. It is one of the most profitable cash crops grown. About one-fourth of the hay crop is sold and nearly all that sold is shipped out of the county. Very few farmers buy any.

The chief hay plant is timothy. Red and alsike clovers are also of much importance. Redtop and Canada bluegrass are also important, especially in the southern part of the county. Alfalfa is proving successful on certain soils in the county. Timothy and clover mixed comprise somwhat more than 50 per cent of all the area of tame and cultivated grasses. Timothy alone occupied 17,775 acres out of a total area of all tame and cultivated grasses in the county, amounting to 66,535 acres in 1919. The average yield in 1919 of all tame or cultivated grasses was about 1¼ tons per acre. In 1919 clover alone was grown on 3,829 acres. Only 265 acres of alfalfa were grown in Tompkins County in 1909, with a production of 615 tons. In 1919, 862 acres of alfalfa were grown in the county. The census of 1875 shows that Tompkins County had 63,280 acres in pasture; acres mown in 1874, 54,756; tons of hay produced, 64,379.

The oat crop is second in importance. Most of this crop is utilized on the farm as horse feed. In 1919 oats were grown on 13,700 acres, with a production of 305,520 bushels, or an average of 22.3 bushels per acre. A few farmers are growing mixtures of oats and peas, or barley, oats, and peas, or barley and oats.

Potatoes are one of the important cash crops and are largely grown on the upland farms, where the soil is well adapted to their production. Most of the crop is shipped out of the county. The principal varieties are the Rural New Yorker, Green Mountain, Worlds Superior, and Number Nine. The average acreage of potatoes per farm is very small. The crop is usually a profitable one. In 1909 there were 4,908 acres devoted to potatoes producing 689,360 bushels, or an average of 143 bushels per acre; in 1919 the acreage was 2,930 acres and the production 347,639 bushels, an average yield of about 118 bushels.

Corn for grain has declined steadily in acreage since 1875. In that year Tompkins County produced 503,154 bushels, while in 1909 the production was only 278,503 bushels, the product of 8,514 acres. In 1919 the acreage had fallen to 4,480 acres and the production to 164,754 bushels. Much of the land formerly used for this grain is now used for producing corn for ensilage. Yields of ensilage range from 8 to 17 tons per acre. Nearly all of the corn grown for grain is flint corn. Dent corn is mostly grown for the silo. Corn does well in many parts of the county. In places, as in the rougher hill section, the growing season is sometimes too short to mature the grain.

Wheat has declined steadily in acreage in Tompkins County. In 1874 the area devoted to winter wheat amounted to 18,184 acres, from which 253,036 bushels of grain were harvested, while in 1919

only 8,911 acres of this crop were grown, with a production of 194,067 bushels. Wheat is a profitable crop on the better soils, particularly on those of heavier texture. It is not only a good crop for its own product, but it is one of the best crops in which to seed grass and clover. This crop is particularly desirable as feed for chickens and can usually be raised much cheaper than it can be bought. About half the production is fed on the farms to poultry. The straw is used for bedding. Winter wheat is grown almost exclusively. The acreage and production in 1919 was somewhat greater than in 1909.

Buckwheat is one of the important cash crops of the county. It is grown on at least 70 per cent of the farms and is one of the most profitable crops for the poorly drained soils and for land that is too wet to plant early in the spring. Most of the buckwheat is sold from the farm. In 1919 buckwheat was grown on 6,789 acres from which 120,318 bushels of grain were produced.

Apples are a profitable crop in Tompkins County when proper attention is given to the orchards. Nearly every farm has a small orchard, but only a very small percentage of these orchards are properly cared for. In 1919 there were 9,717 trees of nonbearing age, 95,752 trees of bearing age, and 56,102 bushels of apples produced in the county. The grape is probably the next most important fruit. There were in the county, in 1919, 26,322 vines of nonbearing age and 65,137 vines of bearing age. The production in that year was 286,215 pounds. The production of small fruits is comparatively unimportant. The value of the fruit and nut production in 1919 was $196,206.

The total woodland in the farms of Tompkins County as given in the 1920 census is 38,592 acres. This is 15.2 per cent of the total area in farms. Besides woodland, there are 28,222 acres of unimproved land in farms, much of which is land that has been cleared at some time in the past.

The adaptation of the various soils to certain crops is well recognized by the farmers of Tompkins County. The acreage devoted to each crop and also the yields per acre are affected by the character of the soil type. In connection with the adaptability of certain soils to crops, it is interesting to note the apparent lack of lime or acid condition of many of the soils. This factor has a direct bearing upon the adaptability of soils for certain crops. The lime factor in the soils of Tompkins County is determinative of the soil productiveness to a greater degree than has heretofore been generally recognized. Calcareous soils to a large extent are found in Ulysses and Lansing Towns. The average value per acre of farms in these towns is greater than in any other towns in the county outside of Ithaca. The highest average, that for the town of Ithaca, is due to the nearness to the city of Ithaca rather than to the quality of the soils. The recognition of calcareous soils as being adapted to alfalfa is reducing to a minimum the chances for failure and discouragement in the production of this legume.

The most modern methods are used in the various types of farming. Nearly all the farmers grow general farm crops, and the great majority keep cows, but the proportion of sales from crops and from stock is quite variable. Wherever possible, machinery is used in the production of crops, and as only a comparatively small acreage of the farms is in tilled crops, these are given good cultivation. A general

practice is to plow the land, especially sod land, in the fall. This is particularly necessary when the soil is expected to be wet in the spring, and also on the heavier clayey soils. The latter practically require fall plowing to produce a suitable seed bed. Grain crops are usually threshed at the barn, straw being stacked or placed under cover for use during the winter. Hay is generally stored in large barns. The potato crop is either sold directly from the field or stored in cellars to be sold at a later date.

The farms generally are well equipped. The farm houses are usually large and substantial. (Pl. XXVIII, fig. 1.) The barns are ample for the accommodation of the dairy animals and other stock and for storing the hay. Silos are found on many farms and more are being constructed every year. There are usually additional buildings for housing wagons, implements, hogs, and poultry. Modern machinery is in common use, including mowing machines, hay loaders, riding plows, harrows, corn and grain drills, reapers, binders, corn cutters, ensilage cutters, potato diggers, and milking machines. Tractor engines are not extensively used.

The work stock consists almost exclusively of horses. The average is about 3 horses to a farm. In 1920 the value of all property per farm was $8,110, of which $5,848 represented value of land and buildings, $788 value of implements, and $1,474 the value of domestic animals.

Practically all of the farmers grow their crops in a more or less definite sequence, but the rotations are not by any means fixed, nor are the acreages grown from year to year at all uniform. The usual rotation is to plant corn, potatoes, or buckwheat on sod. These crops are followed the next year by oats. About two-thirds of the area in oats is seeded with clover and timothy and one-third is followed by wheat and seeding. The land is left in hay for an average period of a little more than three years. There are many variations in practice. The minor tilled crops, such as cabbage and beans, are grown on sod land.

Buckwheat is planted as a catch crop on land that is too wet for planting in the spring and also where a spring-planted crop has failed or where such a crop was not planted because of being behind with the spring work. Occasionally grass seed is sown with buckwheat. Wheat is grown on the better soils only. It practically always follows oats and is followed by hay.

All the available barnyard manure is used, mainly for corn and potatoes, but an increasing number of farmers are using it as a top dressing on hay land. In conjunction with manure, commercial fertilizers are generally used. In 1919, according to the census, 55.5 per cent of the farms reported the use of fertilizer, with a total expenditure of $123,406, or an average of $87.21 per farm. At present the fertilizer used is largely in the form of high-grade acid phosphate. A complete fertilizer high in potash is used for potatoes. Most of the fertilizer is used on potatoes, oats, wheat, and buckwheat. Little is used in growing corn. This crop nearly always receives barnyard manure. On hay very little fertilizer is applied, but the use of nitrate of soda or a fertilizer rich in nitrogen is likely to pay very well. The application of lime is beneficial, especially in the production of clover and alfalfa, on all except a few soils. The lime is commonly used in the form of finely ground limestone.

As in practically all agricultural sections of the northeastern States, the farmers of Tompkins County are somewhat handicapped in obtaining labor, both as to quantity and efficiency. The scarcity of help has been especially severe the last few years, owing to conditions resulting from the World War, but the labor problem has been more or less serious for many years. The greater part of the work on the farms of Tompkins County is done by the farmer and his family.

The average size of farms in the county in 1909, according to the United States Census, was 91.4 acres, of which 72.2 acres was improved land. In 1919 the average size of farms was 99.5 acres. It would appear that the farms are becoming larger year by year. The average size of the farms is greater in Caroline, Newfield, Dryden, and Danby than in the other towns. In considering the larger size of the farms in the rough hill section of the county, consideration must be given to the amount of cultivable land on each farm. Nearly one-fifth of the land in Danby Town is in forest and only 63 per cent of the area is cultivable. The cultivable area in Caroline, Newfield, Dryden, and Enfield Towns is correspondingly low. The average size of the farms is lowest in Groton and Ulysses Towns. The percentage of cultivated land, however, is highest in these towns. The large farms, with a high percentage of cultivable land, appear to be most prosperous. The fact that there are not nearly so many farms as formerly shows the change in farming to meet the conditions that call for larger farms. The fundamental cause for this change is the change from hand labor to the use of machinery. The farmers of Tompkins County are farming more acres per man than formerly and have been increasing the size of farms to meet the situation. The most profitable general farms in Tompkins County contain about 200 acres of good land.

The farms operated by their owners in 1910 constituted 77 per cent and, in 1920, 79.1 per cent of the total farms in the county. Practically all the rest are operated by tenants. Both the cash and share systems of leasing are employed. On the cash basis the landlord, besides furnishing the farm, pays for all extensive repairs or improvements and usually pays the taxes. In a few cases the landlord furnishes the grass seed. On the share basis, where the landlord receives half the produce, it is usually arranged that he pay for all extensive repairs, taxes, furnish the grass and clover seed, and pay half the threshing, hay pressing, and fertilizer bills. The horses are usually fed out of undivided hay and sometimes from undivided grain. The tenant is sometimes allowed to keep a cow or two on undivided hay. The general system of renting when receipts are shared is for the landlord to pay taxes and extensive repairs and half the feed, seed, fertilizer, threshing, and hay-pressing bills, and furnish half the stock except horses, and receive half of all the receipts. The tenant furnishes all labor, horses, and machinery. Many variations occur in the leases as results of circumstances and bargaining. The proportion of tenant farms is greater on the best soils. The average rent per acre is lowest on the poorest soils, but the actual cost per tillable acre is greater.

The value of farm land and buildings in Tompkins County has increased 27½ per cent since 1910, according to figures obtained from the Federal census of 1920. In 1910 the value of land and buildings in the rural part of Tompkins County was given as $11,692,420; the 1920 total is $14,911,779. Tompkins County shows less increase than

any of the three adjoining counties of Cayuga, Cortland, or Tioga. In Cortland County the increase in the value of rural land is 41.6 per cent, in Cayuga County 39 per cent, and in Tioga County 28.1 per cent.

The range in prices of farms per acre in the different parts of the county bears a direct relation to the kind of soil. The low-priced farms are invariably of one particular soil type and the high-priced ones are always of another particular soil type. A considerable number of farms in the hill country in the southern part of the county are for sale at from $5 to $10 an acre. Many farms on the better soils in Lansing Town have been recently sold for around $100 an acre. The highest average value of farms is in Ithaca Town, but this value is influenced by proximity to the city of Ithaca.

Improvement of Agriculture.

The need for definite information regarding the improvement and maintenance of the productiveness of Tompkins County soils is generally recognized. To obtain such information, it will be necessary to consider carefully the various properties of the soil types and to determine their needs through experimentation and observation. The accumulation of the necessary knowledge is only possible at the expense of long and detailed study. Data available at this time do not permit of the inclusion in this report of recommendations for soil treatments other than those of very general character and wide acceptance.

The soil survey in Tompkins County has shown that many soils in the county are badly in need of drainage, especially the Volusia stony silt loam, the Lyons silt loam and silty clay loam, and the Canfield silt loam. Other soils, of less importance than those mentioned, require draining. Therefore, the first step in the improvement of Tompkins County agriculture is to provide complete and efficient drainage, both surface and underground. The problems connected with the drainage of the soils mentioned are not identical, owing to differences in position and in character, structure, and depth of the soil material. It is, therefore, necessary that full information of the properties of the soil be available, as well as a knowledge of the engineering features of drainage installation, if satisfactory results are to be obtained.

The next step in the betterment of the agriculture of the county lies in the improving of methods of handling the various soils. If the fundamental operations of plowing and preparing the seed bed are poorly performed, as is too often the case, no amount of effort in the subsequent tillage can overcome the bad effects. Some of the soils of Tompkins County, namely, the Volusia stony silt loam, Canfield silt loam, and Lyons silt loam, should as a general rule be plowed in the fall. Many factors determine the need of such practice, but it can be said that the physical properties of the soils mentioned are of such character that fall plowing will usually be most satisfactory. Many other soils might well be plowed in the fall, taking into account, of course, the crop to be grown. Some of the soils, on the other hand, should never be fall plowed. Some soils, such as the Groton gravelly loam and the Dunkirk fine sandy loam, can be plowed and handled under a wide range of moisture conditions. For the best success in crop production, plowing—the most important and too often the

least properly performed operation of soil management—should be regulated as to time, depth, and moisture conditions to suit each crop and each soil type. After the proper preparation of the soil to receive the seed it is essential in intertilled crops to follow with frequent and thorough surface cultivation in order to conserve moisture, and last, but most important, to rid the soil of weeds.

Optimum improvement in the productiveness of the soils can not be made without attention to the natural adaptation of soils to crops. The best success in the growing of any crop is only possible when that crop is planted and grown on soils peculiarly adapted to its production. In this connection it is necessary carefully to consider other factors that determine selection of crops for certain soils.

Taking the more important types in the county for consideration, it is seen that the Volusia stony silt loam is one of the least productive soils. The Lansing silt loam is one of the most productive soils. Hay, which is the crop most generally grown in the county, gives an average yield per acre of about three-fourths ton on the Volusia stony silt loam and about 1.5 tons on the Lansing silt loam. Of the total area in crops on the Volusia stony silt loam, 60 per cent is in hay, while only 48 per cent of the Lansing silt loam grows hay. This is not because hay is so good on the Volusia stony silt loam, but because the returns for the greater labor on other crops are so small. Buckwheat is grown extensively on the Volusia stony silt loam for the same reason. The Volusia stony silt loam is a poorly drained soil, sometimes called "hardpan." It is differentiated from the Lordstown stony silt loam on the basis of poor underdrainage. The use of the Lordstown stony silt loam for the production of potatoes is probably greater than in the case of any other soil type in the county. The Lordstown stony silt loam is the "chestnut soil" of the hill country. It is well drained. The recognition given to the adaptation of the type to potato production is determined in part by other factors than soil character. The Lordstown stony silt loam is admittedly a good potato soil, but not any better than the Canfield silt loam, when properly drained, or the Wooster gravelly silt loam. However, the Canfield silt loam and the Wooster gravelly silt loam have a greater diversification in crop production. Crops other than potatoes can be successfully grown, which may fit in better with the system of farming, and consequently the acreage devoted to potatoes is less than on the Lordstown stony silt loam. Certain soil types are best suited to other purposes than purely agricultural because of physical character and topographic situation. The areas of Lordstown stony silt loam, steep phase, and Rough stony and broken land are in general noncultivable and without exception should be used for forestry. Considerable areas of Allis stony silt loam and a few small areas of Volusia stony silt loam are in their present condition so unfit for profitable use for pasture or crop production that they could well be returned to forest. In many cases where an attempt has been made to use such lands for agricultural crops failure has resulted, and the land is at present going back to brush or woodland. Although many of these areas are physically cultivable, economic conditions at present do not justify their use for agriculture.

The recognition of the lime factor as a soil-type characteristic in Tompkins County soils serves to distinguish those soils which are

especially well adapted to the growing of alfalfa and other legumes. The Lansing, the Groton, the Dunkirk, and the Ontario soils are well adapted to the crop and to red clover. The Lyons silt loam, and in some areas the Lyons silty clay loam, when properly drained, should produce legumes without fail. The Lansing silt loam is better adapted to alfalfa than to any other crop. Good stands also are obtained on the Lansing shaly silt loam, shallow phase. (Pl. XXVIII, fig. 2.)

The rotation of crops must also be more carefully planned and followed than ever before, a suitable rotation for each soil type being worked out, and here the fact must be considered that the adaptation of a soil to certain crops limits the kinds of crops which can with the best success be introduced into the rotation.

Manurial and fertilizer practices are of prime importance in considering the increase and maintenance of the productivity of Tompkins County soils. Practically all of the soils of Tompkins County are low in organic matter. All forage crops grown should be fed on the farm, the stable manure being returned to the soil. The rational extension of alfalfa to all soils on which it will succeed, without too great difficulty, and the growing of more red clover and other legumes will aid greatly in improving the condition of the soil.

In order to insure success in the production of legumes in general, liming of the soil is often desirable and sometimes absolutely necessary. The growing of oats and Canada field peas for soiling purposes is advisable, as they furnish a heavy tonnage of valuable succulent feed, and the peas, being a legume, have a recognized value in improving the soil. The plowing under of green manures, such as buckwheat or rye, is desirable under certain conditions.

Much experimental work is needed on all of the soil types of the county, and in this work the individiual soil should be taken as the fundamental basis on which the various types of farming are to be worked out.

SOILS.

The soils of Tompkins County are in part representative of a large area of typically brown soils found in the eastern United States. Many factors have entered into the changes brought about in the character of the soils as they occur to-day. They are derived from a great variety of materials, which have been changed to soils by various processes. Although the color is quite generally a brown or grayish brown, a variation in color exists in many places; there are some soils which are nearly black and others that vary from a light-gray to yellow color.

These various colors are dependent upon, or influenced by, weathering, drainage, amount and character of organic matter, exposure, and cultivation. A great part of Tompkins County was originally forested, principally with sugar maple, beech, yellow birch, hemlock, and white pine. The vegetation may well be said to have reached a normal or balanced stage of adjustment, as reflected by a climax forest growth.

The condition of the soil cover as brought about by the forest's activity at the climax stage is revealed to us to-day in virgin timbered areas. The accumulation and decay of organic matter under such conditions brought about a relatively thin layer of dark-colored surface soil ranging up to 4, or in rare cases to 5, inches in thickness. In dry

condition this horizon below the leaf mold has a dark-brown color. Below this lies a bright yellowish brown horizon. The development of soils under such conditions is to-day revealed in sections of the county where stands of virgin timber remain or the soil has been reforested sufficiently long to bring about similar conditions. Clearing the land and subsequent cultivation brought about the incorporation of the dark-brown layer or its upper part with the second layer, and as a result the present surface soils are generally brown or grayish brown in color.

The textures of the soils range from a fine sandy loam to a heavy silty clay loam, with the prevailing texture a silt loam. The textures of the soils are due in part to the character of the rock materials from which they are derived and in part to the processes by which the soils are formed and their stage of development. In the processes of formation of the soils the underlying shale rock has contributed a great proportion of the materials, and this material is everywhere reflected in the physical character of the soils. Although the range in texture of the soils is great, the variations that occur in the structure of the soils are the most outstanding characteristics of their physical properties.

The consolidated bedrock underlying Tompkins County consists of shale and sandstone, predominantly, and a relatively thin bed of limestone. In only the southern part of the county, however, did these rocks supply the materials out of which the soils have been made. This is due to the processes by which this material was accumulated as unconsolidated rock débris on the surface before the soils were made out of it. This material was accumulated as deposits laid down by glacial ice, by streams which flowed in and from the ice, and by the water of temporary lakes. A great part of this material was brought from regions north of Tompkins County by the glacial ice, a larger part of this foreign material being deposited in the northern fourth of the county. This foreign material included limestone, carried from the northern part of the State, but only a relatively small proportion of the material is made up of limestone, even in the northern part of the county, and in the southern part there is very little to none whatever. The soil material, therefore, had an important limestone constituent mixed with the shale and sandstone material in the northern part of the county, the proportion of the former decreasing southward and of the two latter increasing in the same direction.

The youngest and most variable soils in the county are found in the narrow stream bottoms and basinlike depressions. Included with the more recent alluvium can be classed the soils of arrested decomposition occupying the depressions on the upland. The soil materials of the county may therefore be broadly grouped on the basis of processes of accumulation into the following groups:

(1) Those deposited from glacial ice, consisting of glacial till.
(2) Those accumulated as lake-laid sediments.
(3) Those accumulated as terrace and delta deposits, kames, and eskers.
(4) Those deposited recently by streams.
(5) Those accumulated by the weathering of the country rock in place.
(6) Miscellaneous materials.

The soils derived from these materials are classified according to color, drainage, topography, character of the material, and the processes by which they were accumulated. Consideration of these factors, together with the changes which the soils have suffered in formation, allows the grouping of the various types into 16 series in addition to Meadow, and Rough stony and broken land. The several series have been subdivided, according to the texture of the surface soil, into types, giving 30 types in the county, each of which is shown by a distinct color on the soil map.

Soils Derived from Glacial Till.

In this group are placed the following series: Lordstown, Volusia, Canfield, Wooster, Chippewa, Lyons, Ontario, and Lansing.

These soils are derived from unassorted material known as glacial till or drift. Dependent upon the source of the soil-forming material, the above soils may be further grouped into those derived from calcareous drift and those derived from noncalcareous drift. The former includes the Lyons, Ontario, and Lansing series. A subgrouping is based on the depth of the soil material. The Lordstown soils are defined as those derived from shallow drift. Other subgroups are based on the perfection of natural drainage. The important soil series derived from glacial drift, arranged in the order of the perfection of their drainage, are (1) Wooster, best drained, (2) Ontario, (3) Lordstown, (4) Lansing, (5) Canfield, (6) Volusia, and (7) Chippewa. These soils occupy the undulating to rolling ground moraine and eroded hill section of Tompkins County.

The most extensive soil series in Tompkins County is the Lordstown. The Lordstown soils are derived from a thin sheet of sandstone and shale drift. Usually the underlying rock is less than 3 feet below the surface. The surface soils of this series are light brown to grayish brown and the subsoils are yellowish brown or light yellowish brown. The distinctive feature of the Lordstown soils is their rather friable subsoil. The drainage is usually good. The Lordstown soils occupy the high hill regions in the southern part of the county.

Closely associated with the Lordstown soils are the Volusia soils. The Volusia soils are derived from the glaciation of the underlying Devonian shales and sandstones, much in the same manner as the Lordstown soils. However, the Volusia soils are brownish gray to gray in color and the subsoils are mottled gray, brown, and yellow. The distinctive feature of the Volusia series is the development of a compact subsurface layer resembling a hardpan. This compaction prevents free movement of the ground waters in any direction, resulting in a water-logged condition of the subsoils. The factor of drainage, therefore, serves to distinguish the Volusia soils from the Lordstown soils. Other factors, such as topography, source of materials, and processes of formation, are not essentially different.

The surface soils of the Canfield series are grayish brown to dark gray and underlain by a yellowish-brown to yellowish upper subsoil, which in turn is underlain by a mottled gray, yellow, and brown lower subsoil. The upper subsoil resembles that of the Wooster series, while the lower part resembles that of the Volusia soils. The Canfield soils are typically poorly drained. The deficiency in drainage, however, is not so great as in the Volusia soils. The Canfield

soils are most extensively developed in the northern part of the county, on a comparatively smooth till plain.

The Wooster series represents deep glacial till composed almost entirely of material from light-colored sandstone, conglomerate, and shale rocks, with little or no limestone influence. In color the types of the Wooster series are grayish brown to brown in the surface and yellowish brown to yellowish in the subsoil. Owing to the friable, open structure of the soil-forming material, the soils are well oxidized and the drainage is good. Typically developed, the Wooster soils have no compaction in the subsurface or subsoil. A few areas of Wooster soils do occur in close association with the Volusia and Canfield soils, in which a slight compaction is found in the subsoil; their extent however is small. In topography the Wooster series is rolling to irregularly morainic.

The Lyons series in Tompkins County includes grayish-brown to nearly gray soils, derived through weathering from calcareous drift. The distinctive feature of the series is the poor underdrainage, as shown by the mottled condition of the subsoil. Another characteristic of the series is the pinkish color appearing in many places in the lower subsoil. This latter feature, together with the characteristic structural properties of the subsoil, would indicate that the processes by which the soil material of the Lyons soils was accumulated were somewhat like those giving the material from which the Dunkirk soils are formed. The Lyons series is usually associated with the Ontario and Lansing soils.

The Lansing soils have been derived from the weathering and alteration of glacial till, consisting mainly of shale débris, but containing a relatively small but important limestone constituent. They are developed from true ground moraine. The Lansing soils are usually grayish brown to brown in color. The upper subsoils are brown or yellowish brown. The lower subsoil normally consists of partly weathered till material of grayish color. The Lansing soils are typically calcareous at depths averaging 24 to 30 inches, and the natural drainage is fair to good. These soils are confined to the northwestern part of the county and form an extension of a larger and more typical area in Cayuga and Seneca Counties.

The Ontario soils have been derived from the weathering and alteration of calcareous till occupying country of rolling to semimorainic topography. (Pl. XXIX, fig. 1.) The surface soils, which are characteristically light brown to brown, are underlain by light-brown to yellowish-brown subsoils and in the lower part of the 3-foot section by the grayish partly weathered till. The subsoil has little or no compactness. The soils are well drained and in most places calcareous in the lower subsoil. The Ontario series is typically developed in the drumlin region of north-central New York. In Tompkins County, however, the series is found on morainic ridges, where the soil material appears to be the calcareous equivalent of the Wooster soils.

The soils of the Chippewa series, as found in Tompkins County, are dark gray to nearly black in color. The subsoils are normally mottled gray, yellow, and brown, and are heavier and more compact than the surface soils. The topography is flat to nearly level, the areas occupying depressions or swales where drainage is deficient to poor. The series is found in close association with the Canfield and Volusia soils.

Soils Derived from Lake-laid Sediments.

Based upon the processes by which the soil material was accumulated, certain soil series in Tompkins County are to be considered separately from the aforementioned soils from ice-laid drift. These soils, the Dunkirk and Granby types, are derived from materials believed to have been accumulated as lake sediments.

The Dunkirk soils in Tompkins County have been derived from quiet-water deposits. The soils are yellowish brown to grayish brown in color, in many places tinged with pink. A characteristic feature of the series is the presence of lime carbonate in the lower depths of the subsoil. The topography of the soils is rolling. The series is most extensively developed along the shores of Cayuga Lake and in the tributary valleys. Three types and a phase are mapped in the county.

The Granby soils are derived from shallow water or local lake deposits. The Granby soils, as found in Tompkins County, are dark in color and shallow in depth. The underlying material is a gray to dark-gray, slightly mottled, gritty silty clay to clay, resting upon yellow to white fine sand. The subsoil is calcareous. In topography the Granby soils are flat or low lying. The series is represented by one type, the Granby silty clay loam, developed in a basinlike depression in Fall Creek Valley, southwest of Freeville.

Soils Derived from Old Terrace and Delta Deposits, Kames, and Eskers.

The soils of this group occur as terraces, or deltas in the valleys of glacial and existing streams, and as stratified glacial drift in the form of kames and eskers. They are composed of assorted sand, gravel, and cobblestones and are in places stratified in a complex manner. Such soils in Tompkins County are grouped in the Groton, Palmyra, and Chenango series.

The Groton soils are light brown, brown, or yellowish brown in color, and are underlain by yellowish-brown to yellowish, loose, and porous material resting upon beds of stratified sand and gravel. The Groton soils in Tompkins County have a distinct kame-and-kettle topography. Limestone forms a large proportion of the waterworn fragments in the lower subsoil and substratum. The soils are extensively developed in the large valleys. They also occur as eskers and kames.

The soils of the Palmyra series as mapped in Tompkins County are brown to light brown in color, and underlain by brown to light-brown or yellowish-brown subsoils.

The Palmyra soils are composed of materials laid down as terraces along streams and as deltas in large bodies of water. In profile the Palmyra soils consist of a surface horizon of friable and open material underlain by stratified beds of sand and gravel. The material is calcareous. The distinctive feature of these soils is the fairly even topography, showing the horizontal bedding of water-laid deposits. Both the Chenango and Palmyra soils may be distinguished by the prevailingly level topography.

The Chenango soils are derived mainly from material laid down as terraces, in many cases in ice-dammed waters. The surface soils are brown to dark yellowish brown. The subsoil and substratum are composed of stratified beds of sand and gravel. The soil materials are not calcareous. The topography is prevailingly flat.

Soils Derived from Recent Alluvial Material.

The alluvial soils include types of the Genesee and the Holly series. These soils are of recent origin and are added to by depositions which take place with every overflow along the bottoms of all the present streams. The Genesee soils are brown to grayish brown in color. The surface soil is in most places deep. The lower subsoil consists of brown material slightly if any heavier in texture than the surface. The soils are calcareous. The types of the Holly series have typically gray soils and a mottled gray and brown subsoil. The Holly soils are noncalcareous.

Soils Derived Mainly from Material Accumulated by Residual Decay of the Rocks in Place.

This group, as found in Tompkins County, represents soils that cover areas of smooth to steep topography, which either had no mantle of glacial till or from which the till has been removed by erosion. They consist mainly of fine-textured material derived from the local shale and rest upon the parent rock at comparatively shallow depths.

The types included in the Allis series have light-gray to yellowish-gray surface soils and a gray, mottled with brown, subsoil. Bedrock appears at depths of less than 3 feet throughout the area of this series in the county. The material is noncalcareous. Drainage is deficient. The Allis series as mapped in Tompkins County resembles the Volusia in general character, except that the underlying bedrock is very close to the surface.

Miscellaneous Soils.

Meadow represents low depressions in the upland and in the valleys, where the surface is for the most part covered with water, or exists in a very swampy condition throughout the year.

Rough stony and broken land includes nonagricultural areas of broken and rocky character.

The following table gives the name and actual and relative extent of each soil type mapped in Tompkins County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Lordstown stony silt loam	15,040	17.8	Palmyra gravelly silt loam	3,968	1.3
Steep phase	39,232		Ontario silt loam	3,904	1.3
Canfield silt loam	50,560	16.9	Dunkirk fine sandy loam	3,328	1.1
Shallow phase	832		Wooster stony silt loam	3,328	1.1
Wooster gravelly silt loam	33,728	11.1	Lyons silty clay loam	3,136	1.0
Lansing silt loam	21,888	7.2	Volusia gravelly silt loam	2,560	.8
Allis stony silt loam	17,792	5.8	Holly silty clay loam	1,408	.5
Groton gravelly loam	17,408	5.7	Palmyra gravelly loam	1,344	.4
Rough stony and broken land	15,104	5.0	Lansing shaly silt loam, shallow phase	1,280	.4
Dunkirk silty clay loam	9,984	4.1	Granby silty clay loam	768	.3
Shallow phase	2,496		Chenango stony silt loam	704	.2
Chenango gravelly silt loam	10,048	3.3	Volusia loam	704	.2
Volusia stony silt loam	9,856	3.2	Wooster gravelly loam	640	.2
Volusia silty clay loam	8,128	2.7	Lansing loam	448	.1
Chippewa silty clay loam	8,064	2.7	Dunkirk silt loam	320	.1
Lyons silt loam	7,168	2.4			
Genesee silt loam	4,800	1.6			
Meadow	4,672	1.5	Total	304,640	

VOLUSIA STONY SILT LOAM.

The Volusia stony silt loam consists of a light yellowish brown to light brownish gray, in places mottled, heavy silt loam, about 5 inches deep, low in organic matter, and becoming gray when dry. The subsoil is a gray, yellowish-brown, or brownish-gray compact silty clay loam mottled with gray and reddish brown. The mottled subsoil is very characteristic.

The surface soil contains a large percentage of clay and silt, with only a small admixture of gritty material, and as a result compacts easily. The soil, if undisturbed or not stirred when wet, assumes a crumbly structure upon drying. The action of plant roots is an important factor in bringing about this condition. The line between the surface and subsoil is well marked. In most places there appears at a depth of 5 inches a compact, impervious layer, which is so difficult of penetration that it is often referred to as hardpan. This compact layer restricts the underdrainage and results in the mottled subsoil. The lower part of the subsoil is also compact and impervious, but the zone of highly mottled material in most places lies between 5 and 14 inches below the surface.

Some gravel is found throughout the soil section, but the average quantity is small. Shale fragments varying in size from 28 centimeters down to the smallest rock particle persist throughout the soil section. Large shale fragments are sufficiently numerous to increase the difficulty of boring. Fragments of fine-grained sandstone appear here and there in the material, and in places igneous rocks are encountered, but their occurrence is comparatively rare.

The Volusia stony silt loam is derived from a till deposit coming for the most part from the underlying shale and sandstone formations. The till giving rise to the Volusia stony silt loam is not deep, and the bedrock outcrops in many places.

The Volusia stony silt loam is quite widely distributed over the rougher hill sections in the southern part of the county. The topography determines the characteristics of the type, and the till veneer is so thin and so smoothly laid that the bedrock topography is rarely masked or noticeably modified. Topographically, the Volusia stony silt loam is consistent. In this connection it is to be noted that the type does not occupy wide areas on steep slopes. In all cases the steep slopes were correlated with the Lordstown stony silt loam, steep phase.

The Volusia stony silt loam occurs at any elevation in the county in which the requisite smoothness of topography and imperfect natural drainage are present.

Owing to the rather favorable topographic situation of the Volusia soils, the unsatisfactory physical properties of the soil are overlooked and many farms are located on the type. Many areas of well-drained Lordstown soils occur in similar situations, even adjoining the Volusia soil. The agricultural difference of the two soils is considerable, as farming experience in this section has proved.

The surface features of the Volusia stony silt loam, as found on the hill crests or divides, allow cultivation when other conditions are favorable. On the other hand, because of the compact, heavy subsoil, cultivation is extremely difficult on the slopes and along the valley sides. Such areas are usually in forest and appear best suited to the production of forest products.

The poor subsoil drainage and the presence of the hardpan are largely the cause of the low productiveness of the type. In view of the general poor qualities of the type the expenditure of time and money in improving the drainage is not warranted, under present economic conditions. Careful study of the soil and a thorough understanding of its physical properties are necessary for the satisfactory cultivation of the type.

Field observations made in the course of the survey in this county indicated that the Volusia stony silt loam in forested areas in most places did not have the hardpan layer so near the surface as the type under cultivation. It was also noticed that in many cultivated areas mottling appeared even in the surface soil.

The Volusia stony silt loam is not an important soil in Tompkins County, and it is doubtful if any better use for it can be recommended than to allow it to revert to forest. Of all the upland soils susceptible of cultivation, it is about the lowest in order of agricultural importance. The number of abandoned farms on it is high. Probably 75 to 90 per cent of the type is now in forest or reverting to that condition.

Hay is the crop to which the Volusia stony silt loam is best suited, but, with the general abandonment of the land and consequent neglect, its productive capacity for this crop has been greatly lowered. Orchards are located on this soil in many places, and, although they have often received no attention for many years, one would judge from their appearance and the good flavor of the fruit that under proper care apple growing could be developed. The principal crops grown are hay, buckwheat, and oats. Crop yields are variable. Some of the lowest yields in the county are obtained on this soil type.[2] Again, where the cultural methods are better, very satisfactory yields are obtained.

VOLUSIA GRAVELLY SILT LOAM.

The Volusia gravelly silt loam consists of 12 to 14 inches of dark-gray or grayish-brown (when dry) friable silt loam. The surface soil passes abruptly into the subsoil, which consists of a light grayish brown, friable silty clay loam, mottled with gray and brown. The mottling partly disappears when the soil becomes dry. Gravel occurs throughout the entire soil section, and the substratum is usually quite stony, especially in areas situated on slopes. The soil-forming material is deep, and the country rock has little or no influence upon the character of the soil.

The type is rather uniform in character. Its topographic position is not the same in all cases, but differences in position are not reflected in the soil. One constant characteristic of the type is its comparatively deep surface soil. The soil is friable and easily tilled; the subsoil, although it is mottled and presents a water-logged appearance, is not especially compact or impervious.

The Volusia gravelly silt loam is of small extent in this county. It occurs mainly in scattered areas on lower slopes adjacent to the

[2] The present map varies from older publications in that a separation is made between the better drained Lordstown soils and the poorly drained Volusia soils. It is therefore emphasized that this distinction between the two soils be borne in mind when the type description of the Volusia stony silt loam is read. The Lordstown stony silt loam is a much more productive soil and holds great possibilities as an agricultural soil.

larger valleys in the southern part of the county. An area of the type lies one-half mile south of Slaterville Springs in Caroline Town, and several others are mapped in Dryden and Danby Towns.

The type is derived in part by the weathering and alteration of glacial material modified by additions of débris from surrounding higher lands. Apparently the area mapped north of Brookton has the last-named origin.

The topography of the Volusia gravelly silt loam is gently sloping. The surface drainage is prevailingly good, but the underdrainage is not capable of removing the excess moisture sufficiently well to prevent a water-logged condition of the subsoil. The type is not excessively wet, and only in seasons of abnormally heavy rainfall is the condition of the subsoil of serious consequence. It appears that the run-off and seepage from the surrounding higher lying slopes is in great part responsible for the poor drainage. Most of the areas of the type have been improved by artificial drainage and in normal years produce good crops. Owing to the favorable slope of the type, it is easily tile drained.

The entire soil section is devoid of calcareous material. The organic-matter content is high compared with that of many adjacent soils.

Owing to its small extent, the type is not important. Practically all of it is cleared and under cultivation. Especially good crops of buckwheat and small grains are obtained on the type where it is drained. On some of the better drained areas good yields of silage corn are obtained. The type is utilized mainly for the production of hay and pasture. It is most frequently farmed in conjunction with surrounding soils, and owing to its small extent has not been given much consideration in regard to the most desirable methods of treatment. Aside from drainage, no definite recommendations can be made on the basis of our present knowledge of the soil. It is a desirable farming soil. Many factors, such as proximity to improved roads, markets, etc., are favorable.

VOLUSIA LOAM.

The surface soil of the Volusia loam consists of a yellowish-brown to grayish-brown friable loam 6 to 7 inches deep. The upper subsoil is a yellowish-brown, mottled with gray and brown, rather gritty silt loam. The upper subsoil, which is not especially compact, when compared with the hardpan layer so characteristic of the Volusia stony silt loam, extends to a depth of 20 to 24 inches, where there appears a more compact silt loam, resembling unweathered till, of grayish to dark-gray color, mottled with drab, yellow, and brown.

The soil is quite free of large shale fragments, although some gravel, mainly of shale and sandstone, occurs on the surface and throughout the soil mass.

This soil is developed in Danby Town, in the southern part of the county. In position it is closely associated with the Canfield silt loam, lying near the foot of the more gentle slopes. The topography of the soil is rolling to gently sloping. A few flat areas may occur, but the surface in general is quite rolling.

The surface drainage of the type is fairly good. A few areas, mainly slight depressions too small to map, occur, and in these the soil is in a saturated condition, but the run-off on the whole is fairly

good and the soil dries out fairly fast. The internal drainage is not free, and a water-logged condition of the subsoil results in many areas, as is indicated by the mottling of the subsoil. This condition is aggravated considerably by seepage from the higher lying areas. There appears to be a somewhat open and gritty layer, through which the soil moisture penetrates easily, but the compact underlying till appearing in the lower subsoil is relatively impervious.

The soil material appears to be till brought from considerable distance. It is mainly from shale and sandstone, with some from crystalline rocks. It is comparatively deep and the underlying country rock is nowhere exposed. The soil is comparable to the Canfield silt loam in organic-matter content. It appears to be somewhat darker in color than the Volusia stony silt loam, which is found at a higher elevation. Tests with acid indicate the absence of lime carbonate.

Owing to its small extent, the soil is not important agriculturally. It is utilized for the production of general farm crops, to much the same extent as the Canfield silt loam. It is somewhat higher in productiveness than the Volusia stony silt loam and the crops grown upon it are somewhat more varied.

The Volusia loam is handled like the Canfield silt loam. Fall plowing is quite generally practiced. The type is recognized as a grain and hay soil.

Land of this type sells at a moderate price, accessibility and proximity to markets being factors in its favor.

VOLUSIA SILTY CLAY LOAM.

The surface soil of the Volusia silty clay loam consists of gray or brownish-gray to dark-brown heavy silt loam, 5 to 6 inches deep. The upper subsoil, a layer extending to a depth of 15 to 18 inches, is a gray, mottled with yellow and brown, compact, heavy silty clay loam. This is underlain by gray to drab, slightly mottled with yellow, compact, heavy silty clay loam. The grayish cast of the surface soil is quite pronounced in cultivated fields when in a dry state. The subsoil is relatively impervious to water, and as a result the overlying material is saturated much of the time.

The material forming this type contains a high percentage of silt and clay and only a small proportion of gritty material. The line of demarcation between the surface soil and the subsoil is definite. The compact subsoil material is locally called hardpan.

Shale fragments are scattered over the surface and through the soil section, but the quantity is nowhere sufficient to make the soil a stony type. A few igneous erratics and other foreign material are disseminated through the soil section.

The material of this type represents the weathered zone of a glacial till overlying shale rock. The depth of this till mantle is considerable over most of the section of the county where the type is found, the underlying rock rarely outcropping.

The Volusia silty clay loam is developed largely in Dryden and Enfield Towns, where it is associated with the Canfield silt loam and the Chippewa silty clay loam. The type occupies the flatter areas and gentle slopes of the ground moraine where surface drainage is deficient. A larger proportion of it is cultivated than of the stony silt loam mapped in the rough hill section of the county. This is partly due to its less stony character and also to its more favorable

topographic position. As a whole, the type is low in organic matter. It is also lacking in lime and is acid, though not as deficient in this constituent as the Volusia stony silt loam. Surface and internal drainage are very deficient, owing to the compact, impervious nature of the subsoil and the flat surface.

A large part of the type is devoted to the production of hay and grass for pasturage. Buckwheat returns fair yields and is quite generally grown on this type. Corn for silage and, in some areas where the soil is tile drained, potatoes give fair yields. Owing to the more accessible situation of the type, the use of lime and other fertilizers is more general on this soil than on the stony silt loam.

Land of the Volusia silty clay loam type of soil is farmed in conjunction with surrounding areas of Canfield soils. Plowing under manure and green cover crops, the application of lime, and the installation of tile drains would no doubt benefit the soil in many ways.

ONTARIO SILT LOAM.

The surface soil of the Ontario silt loam consists of about 10 inches of brownish-gray to brown friable loam. The upper subsoil is a light brownish gray to light-brown friable silt loam, only slightly heavier than the surface soil. The lower subsoil consists of a brownish-gray to dark-gray silt loam, somewhat more gritty and gravelly than the soil. The lower subsoil is normally strongly calcareous.

A number of variations occur. The surface soil in many places is a fine loam or a coarse silt loam rather than true silt loam in texture. Owing to the rolling topography, the subsurface material is exposed in places, giving a light-yellow or light-brown color in small areas. This is especially noticeable in a freshly plowed field. Considerable quantities of pebbles and grit are found in the subsurface, which gives a friable, loose structure to the soil. The material in the soil and subsurface layers is normally noncalcareous. The subsoil does not everywhere contain lime carbonate, as the presence of this constituent is erratic in soils of open, friable structure. Only in the lower depths of the subsoil does the calcareous material appear to be uniformly present.

The Ontario silt loam is developed in areas of relatively rolling morainic deposits on the uplands and to a less extent in the valleys. The largest areas are in Ulysses and Lansing Towns, where the type is closely associated with the Lansing silt loam. It occupies slight ridges having a northwest-southeast trend. In all outward appearances the soil does not differ from the Wooster gravelly silt loam where it merges gradually with the Ontario. The line of separation is determined by the presence of calcareous material in the subsoil of the latter soil.

The topography of the Ontario silt loam varies from rolling to hummocky and ridgy, the surface in many places being marked with small kettle holes.

The Ontario silt loam represents deep till, composed very largely of limestone, shale, and crystalline rock materials.

The rolling topography and loose friable substratum insure good drainage.

The Ontario silt loam is not an important soil in this county, owing to its small extent. Approximately all of the type is under cultivation. It is devoted to general farm crops, the yields of which vary

with the topography and methods of cultivation. The type is recognized as a good soil for the production of alfalfa, but applications of limestone are helpful in establishing a satisfactory stand. In the vicinity of Trumansburg a large acreage of beans is planted on this type. The yields are good.

To the general statement that this type is well adapted to alfalfa and clover and the recommendation that manure and green-manuring crops be plowed under to maintain and increase the organic-matter content of the soil, nothing definite can be added. As with all soil types of similar nature found in close association with large areas of other soils, the prevailing farm practice on the larger soil type is followed on the smaller unit. Experimentation based upon results obtained over a considerable length of time is necessary before definite recommendations can be made as to the most profitable and satisfactory fertilizer treatments and crop rotations to follow.

CANFIELD SILT LOAM.

The surface soil of the Canfield silt loam consists of a brownish-gray to light-brown, mellow silt loam, with a depth of about 8 inches. Below this and extending to a depth of 18 to 20 inches, or that zone which may be designated as upper subsoil, is a layer of yellowish-brown to yellow or grayish-yellow moderately compact silt loam, deflocculated and occasionally mottled. The lower subsoil to a depth of 36 inches is a mottled gray, yellow, and brown very compact silt loam to gritty loam. The lower part of the soil section is similar in compactness and mottling to the Volusia subsoil. The substratum is a grayish till composed mainly of materials coming from shale and sandstone. The type is low in organic matter and deficient in lime. Many laboratory tests show, however, that the soil is not as acid as the Volusia soils. Only small quantities of gravel and stone appear on the Canfield silt loam. The shale rock outcrops in the vicinity, and, as on the associated Lordstown soils, angular stone fragments occur on the surface, though nowhere in numbers sufficient to hinder cultivation. The subsoil contains considerable quantities of small fragments of shale, making boring difficult. Very few fragments of sandstone or igneous rocks and none of limestone appear on the type.

The Canfield silt loam is rather extensively developed in the north-central and west-central parts of the county. Large areas lie in Lansing and Dryden Towns, where the type is associated with the Chippewa silty clay loam and Meadow which occur in the depressions; in the west-central part of the county, where it is associated with the Wooster soils, which occupy ridges between the intervening flat areas of Canfield; and in Danby Town, where the associated soils are of the Lordstown series.

The Canfield silt loam in parts of Lansing and Dryden Towns differs from the typical soil as mapped in the west-central part of the county in that the surface soil is somewhat deeper, averaging about 10 inches. The yellowish-brown upper subsoil, recognized as a characteristic of the type, is not everywhere present in this locality. The Canfield silt loam mapped in Danby Town in some respects closely approaches the Volusia soils in character. There is this difference, however; the Canfield silt loam here has a deeper surface soil than the typical Volusia types and also lacks the characteristic hardpan of the Volusia. Many small areas of Wooster gravelly silt

loam, which are too small to show on the map, occur within the Canfield silt loam west of the village of Danby.

Another slight variation in the Canfield silt loam appears in the west-central part of the county, where in slight depressions the surface soil is dark brown in color, but otherwise typical. A considerable area of this color also lies 2½ miles southeast of Malloryville, in Dryden Town.

The Canfield silt loam has been formed through the weathering of transported glacial material mixed with more or less material of local origin. Upon recession of the ice to the north the transported material was dropped to form a comparatively smooth blanket of till. In places the Canfield silt loam represents rather feeble glaciation, the soil material being quite shallow. The shale bedrock in many places is only 3 or 4 feet below the surface.

The Canfield silt loam in general occupies the smoother, more level areas of the glacial-drift plain in the northern part of the county.

The natural drainage of the type is poor, the compact lower subsoil retarding the movement of soil moisture. As a result, the soil under conditions of excessive rainfall quickly becomes water-logged, while with deficient rainfall the crops are likely to suffer from lack of moisture because of poor capillarity. The type is not difficult to drain. The problems connected with the drainage of the Volusia soils are not encountered to the same extent in draining the Canfield soils.

The Canfield silt loam is an important type agriculturally, and where adequately drained is considered one of the more productive soils of the county. The topography is favorable and nearly all the type is cultivable. Approximately 75 per cent of it is actually under cultivation. As is the prevailing custom in this section of the country, many areas are left in woodlots. Most of the Canfield soils utilized for that purpose adjoin areas of the Chippewa silty clay loam.

All the type was originally in forest, consisting chiefly of white pine and hardwoods. The existing forest is all second growth. Elm, beech, and soft maple are the prevailing trees in this growth.

General farm crops common to the section are grown on this type. The yields in general are considerably higher than on the Volusia soils, and in fact compare favorably with those obtained on the Wooster soils. Corn is grown for ensilage principally. Wheat and oats are grown to some extent. Buckwheat also is an important crop, being sown usually on areas that are late in drying out in the spring. Where applications of lime have been made and the land is drained, good stands of clover are obtained. Timothy hay and clover mixed are grown. Good yields of the small grains are obtained. The Canfield silt loam, when drained, is an excellent potato soil.

The improvements and condition of the farms on this type of soil speak well for its productiveness. It appears that tile drainage and the use of lime are essential for successful handling of this soil for the production of staple crops.

The price of land of the Canfield silt loam varies considerably. In some sections of the county, especially in the west-central part, it is relatively high, ranging from $50 to $100 an acre.

Canfield silt loam, shallow phase.—The surface soil of the Canfield silt loam, shallow phase, is a brownish-gray to dark-gray friable loam

or silt loam, with a depth of about 7 inches. The subsoil consists of a yellowish-brown to grayish-yellow silt loam, rather friable and only slightly compact. The depth of the subsoil is variable. In most cases bedrock, consisting of shale, is found at 24 to 30 inches. Where the material has sufficient depth there may be some indications of brown and gray mottling. The mottled condition does not exist as a rule where the soil material is shallow, i. e., where bedrock lies within 10 to 24 inches of the surface.

Considerable quantities of shale fragments are scattered over the surface of this soil. Many of the fragments are large, and in most of the cultivated fields these have been removed and used to build inclosing walls. In places the soil might be classed as a stony type, but nowhere is the proportion of stones so abundant as to preclude satisfactory cultivation.

The Canfield silt loam, shallow phase, is most extensively developed in Lansing Town, in the north-central part of the county. The areas quite consistently are on or near the 1,040-foot contour, on what may be termed the general slopes along Cayuga Lake. The topography is gently undulating to nearly flat.

This phase is poorly drained, this condition arising in most cases as a result of the position of the bedrock near the surface. At certain times of the year a few areas of this soil are boggy and not susceptible of cultivation. However, the excess moisture disappears quite rapidly as the season advances, and in many places the soil is cultivated and worked in conjunction with the surrounding soils.

In origin this soil appears to have been formed contemporaneously with the surrounding till soils; the nearness of the underlying shale rock to the surface is the basis on which it is separated from the typical Canfield silt loam. There is little or no evidence that residual material resulting from the weathering and disintegration of the underlying shale has entered into its composition.

The soil is not important agriculturally, and owing to the small, scattered areas in which it occurs it is not distinctive as far as the general farm practice is concerned. Considerable areas of it are under cultivation, being farmed in conjunction with the associated Canfield and Lyons soils. A few areas are left in pasture and in woodlots. Crop yields average somewhat lower than on the associated soils.

Such land has no definite selling price, owing to the small units in which it occurs. It probably has about the same value as the surrounding Canfield silt loam and Lyons silt loam.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the typical Canfield silt loam:

Mechanical analyses of Canfield silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
163275	Soil, 0 to 6 inches	3.0	4.2	2.4	9.9	14.5	50.4	15.9
163276	Subsurface, 6 to 24 inches	4.6	4.3	2.1	8.3	13.2	46.7	21.1
163277	Subsoil, 24 to 36 inches	6.3	6.7	2.8	10.6	14.2	39.8	19.8

CHIPPEWA SILTY CLAY LOAM.

The Chippewa silty clay loam consists of 6 inches of dark-gray, when dry, to nearly black, when wet, friable silty clay loam, somewhat mottled with grayish brown. The upper subsoil consists of a layer of grayish-brown, rather friable, silty clay loam extending to a depth of about 20 inches. This layer is in places mottled with gray and brown, but this may be considered a variation from type. The lower subsoil is a light yellowish brown to grayish-brown, compact silty clay, normally mottled with brown. The water table lies in most places 20 to 36 inches below the surface.

The surface soil is rather variable in depth and color. It is characteristically shallow, and owing to the admixture of material from the upper subsoil a gray and yellow color may occur in the surface soil. Considerable quantities of flat stone fragments appear on the surface of the type, but at lower depths the type is free from coarse material. The upper subsoil is not especially compact. Both soil and subsoil are noncalcareous.

The origin of the soil is from shale and sandstone till material, which may have been slightly modified locally by water action.

The Chippewa silty clay loam is mapped almost exclusively in the northern half of the county; the topography of the southern part of the county is unfavorable for its development. It is most extensive in Dryden and Groton Towns, where it occurs in narrow strips. It occupies low, flat positions and depressions in the gently rolling ground moraine. Many areas of the type are too small to allow accurate mapping. The surrounding soils are always higher and drain into or through the depressions where the Chippewa occurs. As a consequence it is subject to seepage and is poorly drained.

The Chippewa silty clay loam is not an important type in the county, on account of its small extent and low agricultural value. Considerable attention is given to the type, however, because of the relation the poorly drained soil bears to the adjacent soils. Surrounded as it often is by well-drained land, it calls for drainage work in order to put the land as a whole in the most productive condition.

In many areas the type is left in forest, consisting of elm, soft maple, sycamore, and oaks. In its cleared state the type is used for pasture. When drained good yields of hay are obtained.

The following table gives results of mechanical analyses of samples of the soil and subsoil of the Chippewa silty clay loam:

Mechanical analyses of Chippewa silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
163273....	Soil, 0 to 6 inches..	10.1	2.0	1.0	3.4	4.9	43.6	35.2
163274....	Subsoil, 6 to 36 inches.....	1.1	2.4	1.5	8.5	19.9	46.9	19.7

LORDSTOWN STONY SILT LOAM.

The Lordstown stony silt loam consists of a light grayish brown to light yellowish brown, friable silt loam, low in organic matter and about 8 inches deep, resting on a subsoil of light yellowish brown, heavy silt loam, slightly more compact than the surface soil.

FIG. 1.—FARM HOME AT LAKE RIDGE, LANSING TOWN, SITUATED ON LANSING SILT LOAM.

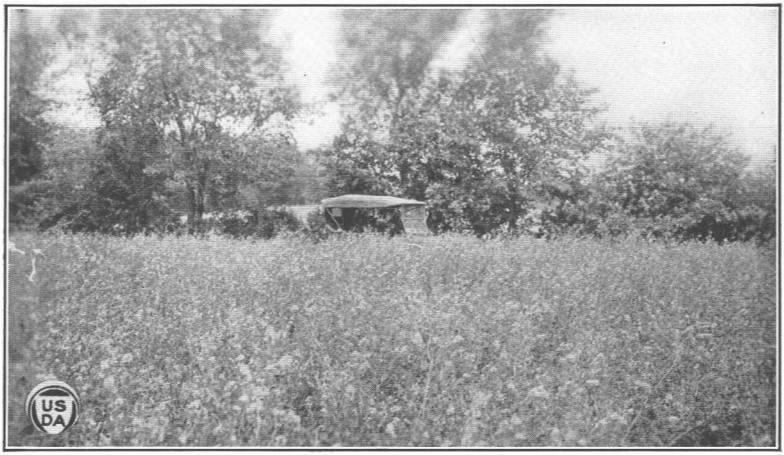

FIG. 2.—ALFALFA ON LANSING SHALY SILT LOAM, SHALLOW PHASE, ON EAST SHORE OF CAYUGA LAKE.

Sharp angular shale fragments appear throughout the soil section, the proportion of such material being slightly greater in the subsoil. The percentage of sandstone fragments is not large, and the occurrence of igneous fragments is comparatively rare. Limestone is not found in the type and it is noncalcareous.

The Lordstown stony silt loam is derived from a till deposit composed chiefly of the decomposition products of the underlying shale and sandstone formations. The soil-forming material is not deep, the shale bedrock appearing at a shallow depth, though not near enough the surface to hinder cultivation over any considerable area. Although of the same derivation as the Volusia soils, the absence of a hardpan stratum in the subsoil and the better drainage make the Lordstown stony silt loam a much better agricultural soil.

The Lordstown stony silt loam is rather uniform in character over the entire area of its distribution. A few areas, as, for example, some on Turkey Hill, in Dryden Town, are sufficiently free of large shale fragments to warrant the classifying of the soil as a gravelly silt loam, but under existing conditions such separation did not seem advisable. The quantity of stones is always greater on the crests of the hills. This condition is especially true in the extreme southern part of the county, where the Lordstown stony silt loam is found at elevations of 1,800 to 1,900 feet. On the more gentle slopes and in the smoother areas the soil-forming material is deeper and the proportion of rock fragments smaller.

The Lordstown stony silt loam is extensively developed in the southern part of the county, in close association with the Volusia soils. The separation of the Lordstown stony silt loam and Volusia stony silt loam is, however, easily determined, although the rugged nature of the topography and the prevalence of forest areas prevent at times the satisfactory delineation of the soil boundaries based upon examination of the soil material. In general, the Lordstown stony silt loam occupies the better drained slopes and crests of the hills and mountains. Below a certain point on the slope, however, the seepage from the surrounding higher slopes gives rise to the Volusia or Allis soils, and the swales and draws, including the heads of the intermittent drainage ways, are in many places so wet as to preclude the mapping of Lordstown in such situations. Very few really flat areas of Lordstown stony silt loam occur, for such areas ordinarily have a distinctly mottled subsoil and are therefore mapped with the Volusia soils.

The topography of the Lordstown stony silt loam ranges from nearly level to rolling. Owing to the influence of the nearly horizontal beds of shale and sandstone, the hills occupied by this type are commonly flat-topped and their upper slopes are prevailingly smooth and well rounded. The drainage of the type is good. In no case is the subsoil compact and impervious in a degree to cause water-logging. In places, as upon rather steep slopes, the surface drainage is excessive and the soil often washes badly.

The Lordstown stony silt loam is an important soil in Tompkins County. It is quite extensive in the rougher hill country and one of the most promising soils of this section of the county, although not

appreciated. The ill repute of the Volusia soils and Allis soils has had a tendency to reflect badly upon all soils in the uplands of the southern part of the county.

The Lordstown stony silt loam is known locally as "chestnut soil" and the Volusia soils as "clay" or "hardpan soils." It is interesting to note that, if the selection of type of soil is indicated by the present location of farm houses, the Volusia stony silt loam was as popular if not a little more popular in the choice of the early settlers than the Lordstown. (Pl. XXIX, fig. 2.)

Dairying and general farming are the principal farm industries. Potatoes are the important cash crop. They yield in an average year about 100 bushels per acre, and yields sometimes reach 250 bushels. Other crops, mainly small grains, produce well. Buckwheat is grown extensively and yields from 15 to 25 bushels per acre. Oats do well, yielding 30 to 50 bushels per acre. Corn for silage is an important crop, yields ranging from 7 to 10 tons per acre. Large areas of this soil type are utilized for the production of hay and as pasture land, the latter especially in conjunction with the adjacent Volusia soils. Ordinarily the quality and yield of hay are not high, owing to the practice of continued cutting until the sod "runs out." Where the land is properly handled, mixed timothy and clover yield 1 to 1½ tons of hay per acre. Apple orchards on this type are thrifty and productive, the quality of the fruit being excellent.

Ground limestone and commercial fertilizers are becoming more generally used on this type. The limestone is beneficial to all crops except potatoes. The application of acid phosphate shows good returns in the yields of small grains. Where available, heavy applications of manure should be made, or green-manure crops, such as rye or buckwheat, turned under. Farming experience shows conclusively that this soil type responds well to proper treatment. The difficulty of hauling fertilizing material to these hill farms is one factor restricting its use. Owing to the importance of this soil type in Tompkins County, it is highly advisable that definite information, based upon experimentation over a term of years, be obtained as to the fertilizer needs of the soil.

The original forest consisted of a heavy stand of white pine, hard maple, chestnut, and beech. Practically all the virgin timber has been removed, but there is much good second-growth forest on the steeper slopes and in the more remote areas of the type.

Where the holdings of Lordstown stony silt loam are large and the condition of the buildings is good, the price of farms varies from $10 to $50 an acre. Location with respect to towns and railroads has an important influence on price.

Lordstown stony silt loam, steep phase.—The surface soil of the Lordstown stony silt loam, steep phase, consists of a light-brown to yellowish-brown stony silt loam, with a depth of about 5 inches. The subsoil is similar in color and texture to the surface soil and in most cases rests upon the bedrock within the 3-foot section. The characteristic feature of the phase is its position on steep, broken slopes. In many places the type includes land too rough to be classed as cultivable. It occurs in close association with the Lordstown stony silt loam. Here and there, as on the east side of the valley in which White Church is situated, a few areas of rock outcrops are included in the type.

The areas of Lordstown stony silt loam, steep phase, are for the most part forested with a second growth of maple, chestnut, oak, beech, and some hemlock and brush. A few areas of virgin forest remain. This consists of maple, hemlock, and white pine. The type where cleared affords fair pasturage. In its typical occurrence the land is best used for forestry. There are many areas, however, which are satisfactory for the production of hay.

WOOSTER STONY SILT LOAM.

The Wooster stony silt loam consists of 8 inches of grayish-brown or yellowish-brown to dark-brown (when moist) friable silt loam, underlain by a subsoil of yellowish-brown to grayish-brown, friable and open gravelly silt loam that extends to a depth of 36 inches or more.

The large stones, which are a characteristic feature of the type, are confined almost entirely to the surface soil. The subsoil may contain a few large fragments, but for the most part the coarse material is made up of angular and subangular gravel and small stones.

The stones strewn over the surface of the type are composed of shale, sandstone, or igneous rock. The average diameter of the fragments is between 8 and 12 inches. Fragments of limestone are never present within the soil section. Many stones have been removed from the fields and used in building fences. At present the stones are not numerous enough to hinder cultivation. The Wooster stony silt loam is an extension of a larger and more typically developed area of the type in Cayuga County.

In Tompkins County the type is fairly uniform in character over the different areas. A slight compaction in the subsoil appears in various places in the flatter areas and depressions, especially along contacts with the Canfield silt loam. This variation occurred in areas too small to map.

The type is mapped in Groton Town, in the northeastern part of the county, where it covers considerable areas. Many areas of the type occur elsewhere in the county, especially in situations where it appears considerable modification of the soil has been brought about by additions of shale from the adjacent Lordstown or Volusia soils, but such areas are small in extent and of no particular agricultural significance and for those reasons are not shown on the map.

The Wooster stony silt loam owes its origin to the weathering of glacial till. The soil-forming material is exposed only in the deeper cuts or gorges. The substratum consists of unassorted glacial débris of an average thickness of 25 to 50 feet.

The Wooster stony silt loam is developed at elevations lying between 1,200 and 1,600 feet above sea level. It is characterized by a gently rolling to rolling topography, and the drainage is adequate, except in places adjacent to the Canfield silt loam, where tile drains would improve the conditions materially. The soil appears to retain moisture well in dry weather. It has very good structural properties and the range of moisture conditions under which it is successfully cultivated is quite wide.

A characteristic feature of the soil type is its lack of lime. The soil is not considered acid to a degree that the growth of legumes is not successful, but tests indicate an absence of lime over large areas

and applications of limestone undoubtedly would prove helpful in obtaining stands of clover or alfalfa. The soil is moderate to low in organic matter.

Practically all of the Wooster stony silt loam is cleared and under cultivation. It is well adapted to the growing of staple crops common to the region. Especially good crops of silage corn, oats, hay, and potatoes are obtained.

In general, about the same type of farming is practiced on this soil as on the Wooster gravelly silt loam. The crop yields are probably not quite as high, on the whole, as obtained on the gravelly type.

Land of the Wooster stony silt loam varies considerably in value, prices ranging from $35 to $75 an acre.

WOOSTER GRAVELLY LOAM.

The Wooster gravelly loam consists of a dark grayish brown, loose, gravelly loam, about 10 inches deep, underlain by a light grayish brown loose gravelly loam extending to a depth of 36 inches or more. The type is variable as to the character of the material occurring on the surface. In places, as one-half mile southeast of Newfield and one-fourth mile east of Stratton, the surface of the type is thickly strewn with shale fragments averaging about 4 to 6 inches in length. Such areas might well be classified as a stony loam.

The type is typically developed 1 mile west of the city of Ithaca, where it occurs in the form of a distinct ridge having a northwest-southeast trend. The Wooster gravelly loam on this ridge merges gradually with the Wooster gravelly silt loam, without any decided change in topography. The ridge apparently represents an old shore line.

The Wooster gravelly loam west of Ithaca is rather variable in composition and arrangement of the soil-forming material. In places a yellow calcareous fine sand, commonly stratified, occurs. Where such deposits are of sufficient size to show, they are mapped as the Dunkirk fine sandy loam. Again, small knolls occur in the ridge which are very similar in composition to the Groton gravelly loam. The type as mapped southeast of Newfield and east of Stratton is not necessarily correlated with shore-line deposits.

The type, where typically developed, is devoid of lime carbonate, although in places small areas containing lime have been included. If they had been of sufficient extent to map on the scale used in this survey, they would have been shown as a distinct type of soil.

The Wooster gravelly loam is not an important soil in the county, owing to its small extent. Most of it is cleared and under cultivation. The surface and underdrainage of the type is usually good.

WOOSTER GRAVELLY SILT LOAM.

The Wooster gravelly silt loam is a light-brown, with a yellowish cast, to grayish-brown friable gravelly silt loam or fine loam, with a depth of 8 inches. The subsoil consists of a light yellowish brown, in places slightly tinged with red, friable gravelly silt loam, somewhat heavier in texture than the surface. The subsoil, where exposed in sections along road cuts, is open and loose, but not to an extent to make the type droughty. The substratum consists of apparently the same material, with similar structural properties as the subsoil.

The gravel in the Wooster gravelly silt loam consists chiefly of waterworn fragments of shale and sandstone, but there is some igneous rock material present. The waterworn fragments seldom are more than 1½ inches in cross section, but angular shale fragments up to 8 inches in their greatest diameter may occur. The presence of this gravel does not hinder cultivation or bring about unfavorable structural conditions in the soil or subsoil. Most of the shale is arenaceous and the decomposition products give a gritty silt loam. This grittiness is a characteristic feature of the type. The soil particles are sharp, and angular quartz particles in a finely divided form constitute a relatively large percentage of the material. The proportion of clay is relatively small. The Wooster gravelly silt loam does not become sticky when wet, and road conditions are usually good in areas of this soil. The soil material is seldom if ever stratified.

In a few areas of Wooster gravelly silt loam a comparatively high percentage of small angular rock fragments (stones) appear, and in an area surrounding Trumbull Corner in Newfield Town the material very closely approaches stony silt loam in texture. The division between a stony silt loam and a gravelly silt loam in the Wooster series is not well marked in this county. Agriculturally, the two types are of the same value, other conditions being equal, except where there is sufficient stone to hinder cultivation.

The Wooster gravelly silt loam is devoid of lime. It may happen that the substratum will carry some lime carbonate, especially in the more hummocky areas characterized by morainic topography. At Kennedy Corner, in Enfield Town, 3 miles west of the city of Ithaca, calcareous material is found at a depth of about 36 inches in the road cut opposite the church, and 2¾ miles northwest of Kennedy Corner a boring showed lime in the subsoil, as did also a boring made three-fourths mile southwest of Kennedy Corner. Careful examination of the surrounding areas did not reveal the presence of lime, and, accordingly, no separation was made. These occurrences and some others in transition zones between the Wooster and calcareous soils are not typical of the Wooster.

The Wooster gravelly silt loam is fairly well supplied with organic matter. It can not be said to be deficient in humus, although the rolling nature of the topography permits slight surface wash and consequent loss of products of plant decomposition. The Wooster gravelly silt loam was not originally a dark soil, and the farm practice of seeding the land down at certain intervals, which is common, and the addition of much barnyard manure probably have built up the supply, the soil containing more now than it did at the time it was cleared of its forest cover. The type is naturally a light-brown soil.

The Wooster gravelly silt loam is normally developed in positions intermediate between the Lordstown and the Volusia soils lying on the hills and the soils derived from morainic and alluvial material in the valleys. Certain parts of the Wooster gravelly silt loam are found at an elevation comparable with that at which the Lordstown and Volusia soils are found. Thus, about 2 miles southeast of Malloryville the Wooster gravelly silt loam persists over a hill whose maximum elevation is 1,600 feet above sea level. Here one would naturally expect to find a thin soil resembling Lordstown stony silt loam. The Wooster gravelly silt loam here represents deep drift, and although there is a

slight compaction in the subsoil the soil material is not to be correlated with the Canfield silt loam, nor is the soil thin enough to be correlated with Lordstown stony silt loam. The agricultural conditions are good here and are in keeping with other localities where the Wooster is extensively developed.

The soil material of the Wooster gravelly silt loam, as mapped around Ellis and north through the valleys connecting with areas of Wooster soils on the south side of the valley of Fall Creek, varies from the typical in that there is present a thin veneer of more or less local material, presumably glacial débris overlying morainic valley fill. The soil here is not droughty, nor is it calcareous.

Another variation occurs in several localities in the county. This consists of a layer of compaction in the subsoil. The layer is not well marked and is not developed to an extent that would restrict drainage. This variation in reality represents a transition between the Wooster and the Canfield soils appearing on the more level areas, where the compact layer is well developed. The variation occurs in the north-central part of the county in Groton, Lansing, and Dryden Towns, and the Wooster gravelly silt loam in this locality is always typical in every respect where it has a rolling surface.

The Wooster gravelly silt loam occurs in two characteristic situations. The most extensive area is found in the north-central and northeastern parts of the county. Here it occupies the typical ground moraine and has a distinctly rolling topography, the areas forming ridges with areas of Canfield soils in the intervening more level areas. The other typical position is illustrated by large areas south of Enfield Falls, near Trumbull Corner, and south of Newfield, where the type lies between the Lordstown or Volusia soils on one hand and the valley soils on the other. Here, instead of occupying ridges, the Wooster soil normally lies on a slope. The occurrence of the Wooster gravelly silt loam on slopes is also well shown on the south side of the valley of Fall Creek, in Dryden Town. Here the type is bordered by the thin hill soils at its upper limits and in most places by the Chenango gravelly silt loam at its lower limit. The soil has good capillarity and is seldom if ever affected by drought or excess moisture to the extent that other upland soils are affected.

The surface drainage of the Wooster gravelly silt loam is naturally good; the underdrainage is free but not excessive. The type is extensive and important in Tompkins County, the percentage of its area now under cultivation being greater than in other types.

All the Wooster gravelly silt loam was originally in mixed forest of hardwoods and pine. At present only small scattered areas of forest exist in the farm woodlots; the value of the type for farming has resulted in almost complete occupation by crops. Many of the most prosperous farms in the county are located on this soil.

Dairying is the principal industry on this type. Corn, oats, potatoes, buckwheat, and other staple crops are grown. The yield of hay is usually good, but the acreage in this crop is not large. Cabbage and other vegetables give good yields.

Land of the Wooster gravelly silt loam type is usually appraised at a higher valuation than any other type of soil in the county. Depending upon condition of improvements and nearness to markets, such land has sold at prices varying from $50 to $100 an acre.

LANSING SHALY SILT LOAM, SHALLOW PHASE.

The Lansing shaly silt loam, shallow phase, consists of a light grayish brown to yellowish-gray silt loam, 5 inches deep, underlain by light grayish brown, compact, gritty to gravelly silty clay loam resting upon shale or limestone within 30 inches of the surface.

The phase is rather variable in composition, in places a stony silt loam. Near the village of Lansing, in Lansing Town, extending north and south along Cayuga Lake, and in other places, as south of Myers Point, the material on the surface is partly limestone, which outcrops in these sections, but some areas rest upon the shale rock and appear to be devoid of lime throughout the soil section. Along Salmon Creek narrow strips of calcareous till are exposed; these have been mapped as the Lansing shaly silt loam, shallow phase.

The phase where it occurs on the east and west slopes of Cayuga Lake has a gently to steeply sloping topography. The narrow strips of the type mapped along Salmon Creek are steep and in most places noncultivable. Notwithstanding the sloping surface of the type, some of the areas are in need of drainage. The wet condition is due to water from seepage and springs. In general, however, the soil is well to excessively drained. It is not retentive of moisture, and most of the water that falls on the land runs off rapidly. Owing to its droughty character, pasturage is usually rather scant in midsummer.

The phase is in most places well supplied with lime, and where the substratum is composed of limestone the soil section is highly calcareous. The soil is usually low in organic matter, owing to the loss sustained by surface wash on the slopes.

This is not an important agricultural soil. In Lansing Town a considerable area is used for pasture. Where the land is cleared and cultivated good crops of hay are obtained. Several good alfalfa fields were noted on the type (Pl. XXVIII, fig. 2.) In some of the more favorable situations extensive vineyards and orchards have been established.

LANSING LOAM.

The surface soil of the Lansing loam consists of dark-brown to grayish-brown, friable, fine-textured loam, with a depth of 6 inches The subsoil consists of a grayish-brown to chocolate-brown, slightly compact, gritty silt loam, extending to a depth of about 20 inches, underlain by a light-brown to grayish-brown gritty silt loam to a depth of 36 inches or more. The lower subsoil is friable and in most places calcareous. The type is somewhat variable and in places the surface soil is a gravelly loam.

Only a small total area of the Lansing loam is developed in Tompkins County. It is mapped in two areas lying about 2 miles north of South Lansing, with a combined area of approximately 450 acres.

The Lansing loam is rolling to gently rolling in topography, and fairly well drained. A few very small areas in the draws are in need of drainage.

Owing to the small extent of the type, it is of little importance. It is farmed in conjunction with the surrounding soils and is regarded as a desirable soil. It appears to be especially well adapted to the growing of clover and alfalfa.

The crops most generally grown and farm methods used are similar to those on the Lansing silt loam.

LANSING SILT LOAM.

The Lansing silt loam consists of a grayish-brown to light grayish brown, friable silt loam, with a depth of 7 to 10 inches. The moist soil in cultivated fields is dark brown. It is fairly well supplied with organic matter and where under cultivation is one of the darkest upland soils in the county. The upper subsoil consists of a grayish-brown compact silt loam grading into a yellowish-brown compact silt loam, slightly mottled with gray and brown, extending to a depth of 24 to 30 inches. The change from the surface soil to the upper subsoil is quite abrupt. The latter, while compact, has somewhat of a crumbly, nut structure when disturbed. Tests, however, do not show it to be calcareous. The lower subsoil is a brownish-gray or dark-gray heavy silt loam, the dark color being due entirely to the color of the shaly drift from which it is derived. The lower subsoil is more gray in color and more friable in structure than the upper subsoil. The mottling common in the upper subsoil seldom appears in the lower subsoil. The material in this zone is highly calcareous.

Gravel is scattered over the surface and through the soil section, but few large stones are found on the surface. The gravel consists mainly of shale, sandstone, and crystalline rocks. Limestone pebbles seldom appear on the surface or in the upper subsoil, but may appear in the lower subsoil, and in places limestone is abundant at 30 to 36 inches.

The Lansing silt loam as mapped in Tompkins County is somewhat variable in texture. West of Salmon Creek, in Lansing Town, the material is a gritty silt loam. On the steeper slopes, as along the west slope of Salmon Creek and on the slopes toward Cayuga Lake, in the neighborhood of Lansing village, the proportion of gravel is large, and limestone pebbles may occur on the surface of the type near the bottom of the slopes.

East of Salmon Creek and west of North Lansing, in Lansing Town, many areas that approach a silty clay loam in texture are included in the Lansing silt loam. In such areas the subsoil is darker in color, being more a chocolate brown than a yellowish brown. South of the East Fork of the Salmon Creek and extending thence southeast to Midway an area of Lansing silt loam is mapped which consists of a coarse silt loam or a fine loam with some gravel in the surface material to a depth of about 10 inches. The upper subsoil in this case is a light-brown or dark yellowish brown friable silty clay loam to about 20 inches, grading downward into a dark-brown or chocolate-brown compact silty clay, slightly mottled with brown and gray. The calcareous horizon here in many places lies below the 3-foot section.

Another variation appears south of Indian Creek, along the State road, near the Odd Fellows Home, where the subsoil in places is somewhat loose. Farther down the slope toward Cayuga Lake the subsoil becomes more compact. The more friable subsoil in this locality is often devoid of lime carbonate within the 3-foot section. The depth of the soil material is rather shallow on this slope, the shale being within 4 or 5 feet of the surface in places.

Southwest of Trumansburg about 1 mile an area of Lansing silt loam is mapped which in places appears to be devoid of lime. Otherwise the soil material resembles Lansing silt loam in that the dark-brown

color of the surface soil and the compact subsurface with the friable subsoil are ever present. The presence of lime was revealed in several places around the outer edges of this area of Lansing silt loam.

An area of Lansing silt loam has been mapped along the banks of Fall Creek east of the university grounds, toward Varna. This area represents exposures of calcareous drift underlying the Dunkirk soils, which occur quite extensively in this vicinity. This soil is not typical Lansing silt loam, and owing to its topographic position is unsuited for crop production over most of its extent. It is a topographic condition rather than a soil type.

The Lansing silt loam has been formed through the weathering of glacial material which for the most part is of foreign origin. This transported material was dropped as a comparatively smooth till sheet. If the word of the geologist is accepted as to the level of the waters of the old glacial lakes, it might be inferred that the Lansing soils of Tompkins County are related to the glacial lake deposits. A striking feature of all calcareous soils in this county is their close association with ancient glacial and local lake deposits. Nevertheless, after considering carefully the arrangement and character of the soil material, it appears that the subsoil of the Lansing soils is glacial till, and while in places the type resembles glacial lake soils in composition, the placing of the soil with that group is not justified by the evidence.

The Lansing silt loam is confined almost exclusively to the northwestern part of the county, in Lansing and Ulysses Towns. It seldom occurs above the 1,000-foot contour. The type is found in close association with other calcareous soils, from which it is separated mainly on the basis of the character of the subsoil. The boundaries between the Ontario silt loam and the Lansing silt loam in Lansing Town are rather indefinite. Those soils classified as Ontario silt loam have a more open and friable upper subsoil than the typical Lansing silt loam, but in places where the morainic topography, which is a characteristic feature of the Ontario silt loam, is not well developed, there is a natural gradation from the more compact subsoil of the Lansing to the open and loose subsoil of the Ontario, making mapping difficult. There was also some difficulty in separating the Lansing silt loam from the Lyons soils.

The topography of the Lansing silt loam is for the most part undulating to gently rolling. The areas lying on the slopes of Salmon Creek and Cayuga Lake have a somewhat different surface, being moderately sloping.

The Lansing silt loam is fairly well drained. There are some areas west of North Lansing and also near the county home in Ulysses Town that, owing to the compaction in the upper subsoil, would be benefited by laying tile drains. Many small areas within the Lansing silt loam represent Lyons silt loam and would have been mapped as this type if the scale of the soil map had permitted. Such areas of poorly drained soil are found on nearly every farm and require tile drainage for their proper reclamation.

The Lansing silt loam is a fairly extensive soil type in this county, and is important agriculturally. A large proportion of it is under cultivation. The draws leading down to the streams and the

lake are left in timber, but those areas of the type susceptible of ready cultivation are intensively farmed and produce excellent crops.

The Lansing silt loam is an alfalfa soil. Additions of lime may at times be necessary in order to get the crop well established, but the deep-rooting plant soon reaches the supply of lime in the subsoil and becomes firmly established. The type is especially well suited to all of the staple grain crops. Excellent yields of corn and wheat are produced on the type. Corn is largely cut for ensilage. It yields 10 to 12 tons per acre. Cabbage produces from 6 to 10 tons and potatoes from 75 to 100 bushels per acre. Some oats and buckwheat are grown. Several large vineyards are located on the type. Crop rotations are followed by practically all farmers on this type. All available barnyard manure is put upon the soil. Commercial fertilizers are generally used with wheat.

Land consisting of this type of soil is well esteemed and is usually appraised at a higher valuation than surrounding soils. With fair condition of improvements farms of this type usually sell around $100 an acre.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Lansing silt loam:

Mechanical analyses of Lansing silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
163268....	Soil, 0 to 7 inches..	5.0	5.5	2.9	13.8	16.9	43.7	12.5
163269....	Subsurface, 7 to 30 inches.....	3.0	3.3	2.4	12.6	19.6	41.8	17.3
163270...	Subsoil, 30 to 36 inches.....	3.6	5.9	3.0	14.4	18.8	36.7	18.0

LYONS SILT LOAM.

The Lyons silt loam is a light grayish brown, when dry, becoming grayish-brown, when wet, compact silt loam, with a depth of 10 inches. The subsoil to a depth of about 20 inches consists of a light grayish brown compact silty clay loam mottled with light gray and brown. Below 20 inches the subsoil becomes somewhat darker in color and slightly more compact and mottled in the lower part with brown and drab. The material in the lower depths of the soil profile is commonly calcareous; the substratum is always so.

Small angular fragments of rock, mainly shale, appear throughout the soil section, becoming more numerous in the lower stratum, which consequently is a little more friable and open than the overlying material. Some limestone and chert fragments also appear in the lower subsoil. The surface soil is deep and has a characteristic granular structure. It is quite distinctly separated from the upper subsoil, which is a compact layer.

The Lyons silt loam is quite uniform, so far as the soil is concerned, over the entire area of its distribution. The type as developed in the neighborhood of South Lansing in Lansing Town shows in many places a variation in the character of the subsoil. In this locality it appears probable that remnants of old glacial-lake deposits

are present below the surface. This is indicated by the characteristic structure, the pinkish color, and the absence of gritty material in the lower subsoil. The soil-forming material in this locality is shallow, and the substratum rests upon shale and limestone bedrock at an average depth of 4 or 5 feet, the rock outcropping in many places. To a certain extent the Lyons silt loam mapped south of Trumansburg is of the same character. A careful study of the soil profile over large areas, however, shows that the gritty, heterogeneous material resembling glacial till is sufficiently well distributed to warrant the inclusion of the soils in the Lyons series.

It is recognized that the areas of Lyons silt loam just mentioned are not to be correlated without qualification with the same type near Lake Ridge in Lansing Town or with like areas in Cayuga County to the north. The areas near Lake Ridge and north in Cayuga County are closely associated with the Lansing silt loam, which soil in reality represents a better drained Lyons silt loam,

The Lyons silt loam is developed only in the northwestern part of the county. As with many of the soils that contain considerable lime, its occurrence appears to be closely related to the area once covered by ancient glacial-lake waters. Nevertheless, although part of the area covered by the type was subjected to lake conditions, there is for the most part but little evidence of sedimentation.

The Lyons silt loam is derived from glacial material brought from the north, the deposits in many places being thin. The topography is undulating to gently sloping and the type is naturally poorly drained, underdrainage being especially imperfect. In places the water-logged condition of the subsoil does not appear to be very serious, but tile drainage is necessary on most areas before tilled crops can be produced satisfactorily. Many areas of favorable slope or position now produce fair yields of grain and hay in normal years without artificial drainage, but the mottled subsoil would indicate that underdrains would be beneficial throughout the type.

The type is not extensively developed in the county. It is, however, considered an important soil agriculturally. It is inherently productive and situated well with respect to markets and improved roads. Most of the type is cleared and in cultivation. Some areas, mainly near the draws, are in pasture and woodlots. The type produces good crops of the small grains in normal years. Buckwheat yields well. The yield of hay, consisting of mixed timothy and clover, compares favorably with that on the adjacent soils. With thorough underdrainage the type would be well suited to the growing of alfalfa. Sweet clover grows luxuriantly along the roadsides.

LYONS SILTY CLAY LOAM.

The Lyons silty clay loam consists of 8 inches of grayish-brown to dark-gray silty clay loam, low in organic matter, passing abruptly into a chocolate-brown or grayish-brown, with a decided pink cast, compact, silty clay to clay, slightly mottled with drab. At about 20 inches the material changes to a light grayish brown to light-gray silty clay, somewhat less compact than the overlying layer. The lower subsoil is calcareous.

The surface is practically devoid of stone and gravel. The action of plant roots, together with the effects of weathering, produces a

crumbly structure in the surface soil, but if it is disturbed when wet the material puddles and becomes very intractable. The upper subsoil is usually quite free of stone or gritty material. Although it is very compact, it apparently does not cause a water-logged condition in the soil. A feature of this layer is its pinkish cast and resemblance to the glacial-lake clays. The granular structure so prevalent in the glacial-lake clays is, however, not well developed. The material has a slick or soapy feel, somewhat like that of the residual products derived from the dark-colored carbonaceous shales. It is seldom calcareous, unless a limestone fragment happens to be present. Lime is never disseminated throughout this layer.

The change from the upper to the lower subsoil is quite abrupt. The latter has considerable gritty material and small stone fragments in it, which tend to make it more open and friable than the upper soil layers. The lower subsoil is seldom mottled. In places small specks of brown and olive drab may occur and patches of gray may appear, the last being due to the presence of lime carbonate in an amorphous state. In some such areas the subsoil resembles marl.

The Lyons silty clay loam is found in small, scattered tracts near South Lansing in Lansing Town, in an area containing more than 1 square mile northwest of Lansingville, in an area east of Ithaca, and in small areas elsewhere in the county. The type as developed near South Lansing is associated with the Lyons silt loam, the slight depressions or flat areas within the latter type containing the heavier textured soil. The till here is not deep, the shale bedrock appearing at an average depth of 4 feet. The area northwest of Lansingville is not typical, the upper subsoil being less compact and lacking the pinkish tinge found in the areas around South Lansing. The subsoil is strongly mottled with brown and drab.

The type here occupies a flat of wide extent, in close association with the Lansing silt loam, and might with equal propriety have been mapped as a poorly drained phase of the Lansing. Several small, scattered areas of Lyons silty clay loam occur east of Salmon Creek which bear the same relation to the Lansing silt loam. The only other area of the type of any consequence is situated about 2 miles east of Ithaca, south of Cascadilla Creek. The type here lies adjacent to an area of Dunkirk silty clay loam, but has the characteristics of the soil as mapped near South Lansing.

The topography of the Lyons silty clay loam is flat to gently undulating. The smaller isolated areas occur in slight depressions. In places the surface has a very gentle slope, as north of Lake Ridge, in Lansing Town.

The type is naturally poorly drained throughout the area of its distribution, but responds readily to underdrainage. Excellent crops are grown on some of the drained areas. Satisfactory drainage not only allows the use of the soil under a wider range of moisture conditions, but, causing better tilth, lessens the danger of drought in seasons of deficient rainfall. Unless the type is drained it is not considered productive. It is not an important type in the county, owing to its small extent.

DUNKIRK FINE SANDY LOAM.

The surface soil of the Dunkirk fine sandy loam is a grayish-yellow, or when moist brown to light-brown, friable, fine sandy loam or fine

loam, low in organic matter, and about 8 inches deep. The subsoil consists of a light yellowish brown very fine sandy loam, slightly mottled with gray and rusty brown. The subsoil contains enough silt and clay to hold the sand particles closely together. Lime is invariably present in the more or less compact lower subsoil.

Considerable quantities of small waterworn gravel are found on the surface; the subsoil is usually free of stone or gravel. The surface soil is characterized by the absence of clay particles and the relatively high percentage of finely divided quartz or sand grains. The sand particles are well rounded. The roads traversing the type are very sandy. The type does not retain an excess of moisture for any length of time, and as a result the roads are in good condition when other areas are more or less muddy. The subsoil, although it contains sufficient silt and clay to bring about compaction in its undisturbed condition, upon exposure and removal breaks down into a loose, pulverulent mass.

The substratum of the type consists of a laminated very fine sandy clay or clay having the characteristic structure and color of the glacial-lake deposits. The character of the substratum, however, is variable. In some places, as 1 mile north of West Danby, the glacial-lake clays are present under the sandy clay at a depth of 5 or 6 feet. The lake deposits here have lenses of medium-textured black or white sand, which are highly calcareous, especially the black sand. Small pebbles of blue limestone appear in the substratum of clay. In other places the type rests upon stratified deposits of gravel and medium to coarse sand.

Many variations in the character of the subsoil and soil also occur. Instead of being slightly compact and showing evidence of sedimentation, the subsoil is in many places loose and somewhat porous. An area mapped three-fourths mile west of Malloryville, in Dryden Town, has this character. In some places the surface may be silty and overlie a sandy subsoil, in others it may be a loam underlain by silty sandy loam or clay. Owing to the small extent of these variations it is impossible to show the areas on the soil map accurately.

South of Trumansburg about one-half mile an area of Dunkirk fine sandy loam is mapped which is variable as to texture and arrangement of the soil material. The surface is a sandy loam to fine sandy loam in texture. The arrangement of the soil material does not indicate clearly that the soil should be correlated with Dunkirk fine sandy loam. In places the material is well stratified; in others it appears that unassorted glacial material has been laid down upon the surface.

Many small areas of Dunkirk fine sandy loam occur in various parts of the county, which, on account of the scale of the map, are not indicated. Especially is this true within areas of Canfield silt loam. One mile southeast of Enfield Falls, in Enfield Town, several such areas occur. Their scattered, irregular occurrence and small extent did not permit satisfactory mapping. Parts of these areas, which are small, have a decidedly kame-and-kettle topography. The soil is, however, better correlated with the Dunkirk fine sandy loam than any other soil.

The Dunkirk fine sandy loam is distributed in scattered areas throughout the old glacial valleys and their tributaries. One of the largest areas is developed near West Danby. Other areas of considerable consequence are mapped north of Forest Home, at East Ithaca,

and near Varna. All these represent true delta material. Other areas of the type are found three-fourths mile west of Malloryville, at Asbury, and south of North Lansing. The areas in Lansing Town are not true to type, the evidence of sedimentation being slight.

The forces acting in the formation of the Dunkirk fine sandy loam were aqueo-glacial. Practically all that part of the county where this soil is developed has been covered by old glacial lakes. The areas that can not be definitely correlated with lake deposits, owing to the slight evidence of sedimentation, are probably derived from materials reworked by shallow waters that did not exist for long enough periods to allow the accumulation of much sedimentary material.

In general, the surface of the Dunkirk fine sandy loam is undulating, especially in those areas clearly of delta formation, to decidedly rolling, as in the Inlet Valley. In the latter the surface is made up of knolls and ridges, with many potholes where the drainage has been obstructed.

The natural drainage of the type is generally good. Some of the depressions would be benefited by drainage. The soil appears able to retain a large quantity of moisture and give it up readily to the growing crops as needed.

The Dunkirk fine sandy loam is a comparatively unimportant soil agriculturally, its total extent being only a little more than 5 square miles. In some situations the type is excellent farming land; in others it is not so good, the value being dependent to a great extent upon the topography and the size of the tract. The type is adapted to a wide range of crops. Corn does well on this type, the sandy nature of the soil making it warm and especially favorable for maturing this cereal. Alfalfa should prove a successful crop.

The selling price of this land is usually dependent upon the character of the adjacent lands.

DUNKIRK SILT LOAM.

The Dunkirk silt loam consists of 5 or 6 inches of light yellowish gray to grayish-brown friable silt loam practically free of stone or gravel. The subsoil is a yellowish-gray to light-gray more compact silt loam to silty clay loam. The surface soil is comparatively shallow and has a smooth feel. The subsoil is in places somewhat gritty. The substratum consists of thin beds of stratified silt and fine sand.

The subsoil is rather compact in structure, like the typical glacial-lake deposits, but the characteristic crumbly or nut structure and the peculiar pinkish shade of color present in so many places in the lake clay is wanting. Sections obtained in road cuts indicate that the type was formed under conditions of shallow-water sedimentation. The substratum and lower subsoil show the lamination of clay, silt, and very fine sand, characteristic of a shallow-lake deposit.

Only three small areas of the Dunkirk silt loam are mapped in Tompkins County. Two of these lie north of Waterburg, in Ulysses Town, and the third in the southern part of the county, south of West Danby. The combined area is one-half square mile.

The areas of this soil have a sloping to nearly flat surface, but owing to the structure of the subsoil the underdrainage is rather poor. The type is all cleared and under cultivation. It is well adapted to the production of hay. Where the drainage is fair, good crops of

the small grains and silage corn are obtained. In fact, the type is recognized as being especially a hay and grain soil.

DUNKIRK SILTY CLAY LOAM.

The surface soil of the Dunkirk silty clay loam consists of 8 to 12 inches of light-brown, yellowish-brown, or grayish-brown silty clay loam, which becomes quite gray in color when dry in cultivated fields. The upper subsoil, to a depth of about 24 to 30 inches, is a light yellowish brown to light-brown tinged with pink, heavy, compact silty clay loam to silty clay. In places the upper subsoil may be slightly mottled with gray and yellow, the gray predominating. The lower subsoil consists of a light yellowish brown, sometimes streaked with gray, compact silty clay to silty clay loam. A decided pinkish tinge commonly appears in the lower subsoil. Both soil and subsoil are free of stone and gravel. A few waterworn pebbles may occur on the surface. Lime is seldom found in the upper subsoil, but usually occurs below about 30 inches, the lower subsoil being highly calcareous. In fact, the appearance of lime is more consistent in this soil than in any of the other calcareous types of the county.

The substratum consists of a tough, compact blue clay high in lime. The line of demarcation between the weathered material and the unweathered clay is very sharp. The characteristic nut structure appearing in the weathered zone is entirely absent in the clay.

The Dunkirk silty clay loam is rather uniform in character over its entire area of distribution in the county, but some minor variations occur. Thus, east and northeast of the city of Ithaca in places the depressions within the type are occupied by a soil somewhat darker in color and deeper than typical. The subsoil here is, however, essentially typical, and the areas being small, they were not separated. Many small areas of Dunkirk silty clay loam, too small to show on the map, have been included with other soils. This condition exists especially in Dryden and Groton Towns, where small areas of the type lie adjacent to areas mapped as Meadow.

The Dunkirk silty clay loam is found in rather scattered bodies along the more important drainage ways of the county. The glacial-lake clays, including the marginal lake deposits, from which the type is derived, occur on the valley slopes which were a part of the high-level lake bottoms. The Dunkirk silty clay loam seldom rises above the 1,100-foot level. Owing to the readiness with which the type is eroded, many of the lower slopes are devoid of the type. The material from which the soil has been formed consists of the finer glacial débris, and the deposition of this material in the comparatively quiet waters of temporary glacial lakes accounts for the topographic position of the type.

The topography of the Dunkirk silty clay loam consists of undulating or rolling to rather steeply sloping hillsides. Drainage is fair. Water falling on the more level areas has little opportunity to escape, except by evaporation. Seepage downward is slow and difficult on account of the fine division of the soil particles and their close, compact arrangement. Tile drainage is essential over practically all of the type occupying the more level areas.

The Dunkirk silty clay loam is a type of moderate importance, covering a total area of approximately 10,000 acres. Probably 90

per cent of it has been cleared and placed under cultivation. It was originally forested, mainly with hardwoods. The soil is difficult to cultivate, and consequently many of the rolling areas are utilized for the production of hay crops, to which the type is well adapted.

Good stands of alfalfa are seen upon this type. The type is also a good soil for the production of grains. Wheat yields from 15 to 35 bushels per acre, oats 40 to 50 bushels, and hay, 1½ to 2½ tons. The yield of corn, which is mainly cut for ensilage, is fairly high on the more level areas of the type. Potatoes are not grown on this type as a rule. Where the land is thoroughly drained, fruit trees do well if properly cared for. Tile drainage and the incorporation of organic matter are needed to improve the physical condition of the soil.

This type varies so considerably in value that no reliable average estimate can be given. Many well-improved areas near Ithaca have sold for $100 or more an acre.

Dunkirk silty clay loam, shallow phase.—The surface soil of the Dunkirk silty clay loam, shallow phase, consists of about 8 inches of light-brown to grayish-brown heavy silty clay loam, which becomes quite gray in color in dry cultivated fields. The upper subsoil is a light yellowish brown to grayish-brown compact silty clay loam. Bedrock, consisting either of shale or limestone, commonly lies within 3 feet of the surface.

This phase has about the same surface characteristics as the typical soil, except that somewhat more fragmentary shale appears. Owing to the nearness of the bedrock, seepage areas are more common. This is especially true on north slopes, where moisture is held in the soil late in the season. In other areas, where the conditions are not favorable for seepage, the type may be rather droughty in character. In such places the soil may be wet and sticky in the spring, and crops may suffer for want of moisture in the summer. This is especially true on the west and south slopes. The type is only fairly well supplied with organic matter, and as a rule is devoid of lime carbonate, the material being rarely deep enough to include the horizon at which the calcareous material normally appears.

The type is utilized for various purposes. In some locations dairying appears to be important. This is due to the situation of areas near Ithaca. Alfalfa and clover are grown with fair success on the type. Mixed clover and timothy give good yields where the soil is fairly well drained. The type appears to be best adapted to the production of small grains and hay. A considerable area is utilized for pasture. Some fair apple orchards are found. This soil is not extensive in the county. Owing to its favorable situation with respect to markets, the land, considering the character of the soil, is usually held at fairly high figures.

GRANBY SILTY CLAY LOAM.

The Granby silty clay loam is a dark-gray, with a pinkish tinge, when dry, to dark-brown or nearly black, when wet, heavy silty clay loam, with a depth of 4 or 5 inches. The subsoil consists of a light grayish brown, rather friable, gritty, silty clay loam, mottled with brown and gray. The lower subsoil is normally calcareous, the lime occurring in an amorphous form and well disseminated through the material.

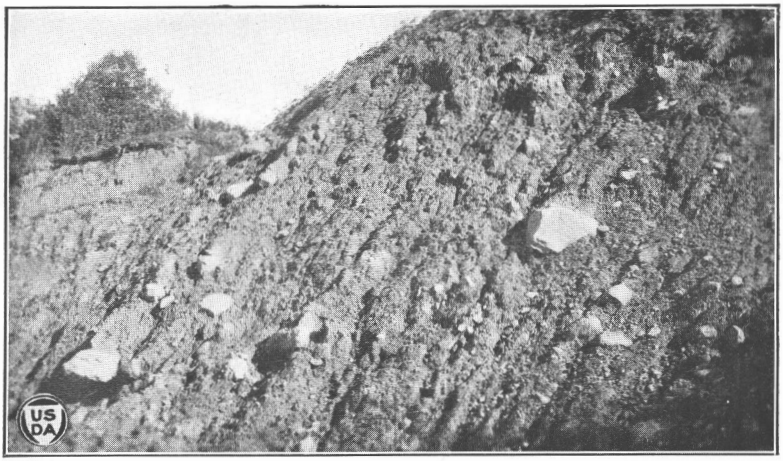

FIG. 1.—CALCAREOUS DRIFT IN SIXMILE VALLEY.

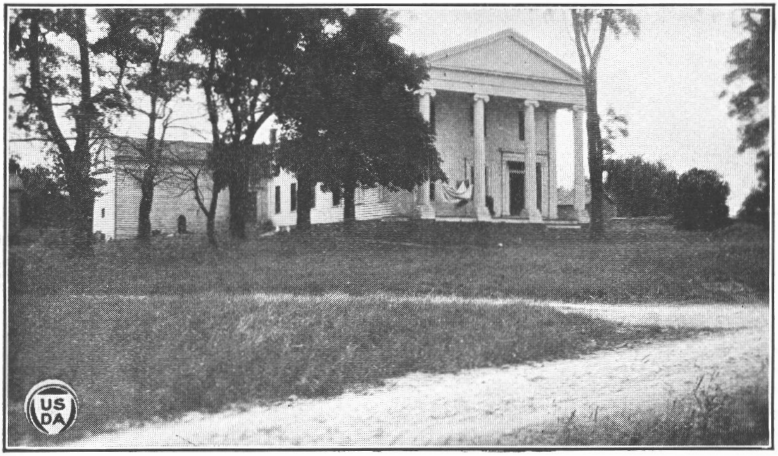

FIG. 2.—FARM HOMESTEAD 3½ MILES NORTHEAST OF SPEEDSVILLE, LOCATED ON VOLUSIA STONY SILT LOAM AND LORDSTOWN STONY SILT LOAM.

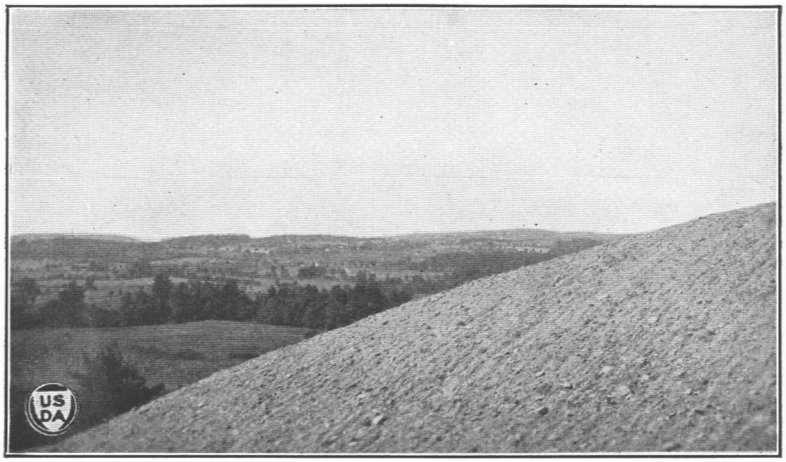

FIG. 1.—EDGE OF DELTA FACE LOOKING TOWARD ENFIELD, MAPPED AS GROTON GRAVELLY LOAM.

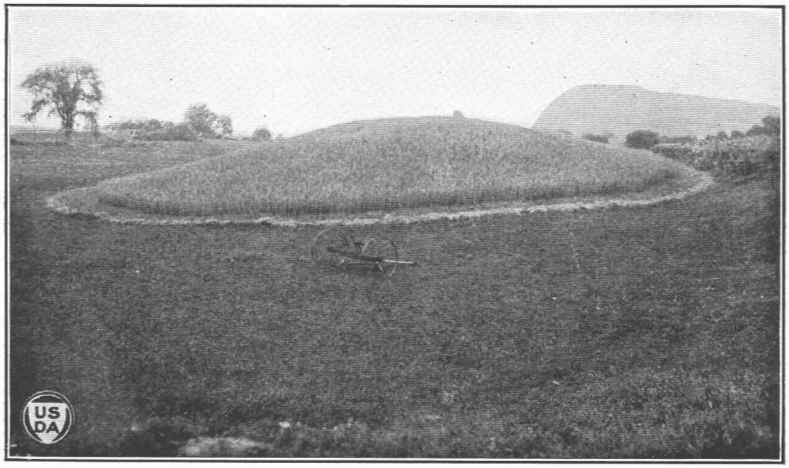

FIG. 2.—KAME DEPOSIT MAPPED AS GROTON GRAVELLY LOAM, ON WHICH GRAIN WAS SOWN. LAND SURROUNDING KAME IS WET AND USED FOR PRODUCTION OF HAY.

The characteristic features of the type are the prevailingly shallow surface soil, its comparative freedom from stones and gravel, the faint pinkish tinge, which correlates it with the old-lake deposits, and a marked tendency to puddle if disturbed when wet. The change from the surface soil to the subsoil is abrupt, especially the change in color. The subsoil, although rather plastic and sticky, contains considerable gritty material and small gravel, sufficient to bring about an open structure. The water table lies relatively close to the surface and in many places it is impossible to obtain a sample of the lower subsoil on account of water.

Some variations in surface soil and subsoil appear. The color of the surface soil is lighter on slight rises that occur in the generally flat surface, being yellowish brown or grayish brown. A subsoil variation consists of the appearance, at lower depths, of stratified white or yellow sand of the medium and fine grades. Such deposits commonly occur in the flat or depressed areas and are in most cases calcareous.

Areas of the Granby silty clay loam lie in Dryden Town. The largest, containing about 1 square mile, is mapped 1 mile southwest of Freeville. A small area lies just west of Junior Republic. The type appears to have been formed under lacustrine conditions.

In general, the topography of the type is flat. In places there is a slight slope toward the center of the area, owing to the addition of material from the higher lying slopes to the south. Also, a few small areas of till appear as ridges within the type; these were not separated, though it is recognized that they belong in another series.

Owing to the physiographic position of the type, it is poorly drained, and the lack of satisfactory outlets will make drainage as a whole a difficult matter.

The type is not an important soil in the county, and in its present state it is unsuited to production of tilled crops. It has value as pasture and also as hay land. For the production of hay, principally timothy and alsike clover, it is unexcelled, especially when drained.

GROTON GRAVELLY LOAM.

The surface soil of the Groton gravelly loam consists of 8 inches of a brown to grayish-brown gravelly loam, fine in texture, and of loose, open structure. The upper subsoil is somewhat lighter than the soil in color and differs but slightly in the texture of the fine earth or in gravel content. At varying depths, ordinarily at about 30 inches, the subsoil becomes a mass of loose, porous sand and gravel prevailingly calcareous. The gravel throughout the soil section is almost all waterworn, and subangular to roundish in form.

In general, the proportion of gravel or stone is not large enough to make cultivation difficult, but small spots do occur on the tops of kames, where coarse gravel is so abundant that it is a hindrance. The gravel is composed chiefly of shale, but limestone, red and gray sandstone, and chert are represented, especially in the substratum, and erratics of igneous origin, coming, it is believed, from the Adirondacks, appear in the soil mass.

The type is quite uniform in its principal characteristics throughout the occurrence in the county. Some slight variations in texture

of the surface soil occur in places. Thus, in the large area mapped south of West Danby the proportion of very fine sand is slightly larger than typical.

A somewhat similar variation appears in the area lying about 1 mile east of Slaterville Springs, which has a relatively high content of fine sand. In the former area considerable quantities of flat shale fragments have been carried down on the type from the adjacent steep Lordstown slope. Stone fences composed of shale and igneous rock are found also on the type just north of the county line toward West Danby. This condition is not prevalent over any wide areas, and it was considered impractical to separate the areas as a stony loam type.

The identification of the soil type is in many cases difficult, and the line of separation between it and the closely associated Wooster soils is in many instances arbitrarily placed. The areas occupying kames, eskers, and eroded deltas are easily recognized. (Pl. XXX, fig. 1.)

The Groton gravelly loam is developed in several different positions in the county. The most extensive areas lie in the larger valleys, and occupy irregular morainic areas. Other bodies occur in the neighborhood of the large valleys, where the material was originally laid down in the form of deltas and modified subsequently by erosion. Still others occupy distinct kames and eskers.

The Groton gravelly loam is derived from drift deposited in these various topographic forms by streams flowing from the glacier. The topography is broken and morainic, with a distinct kame-and-kettle formation. (Pl. XXX, fig. 2.) Owing to the gravelly texture and open structure of the soil, natural drainage is good and in places excessive.

The Groton gravelly loam is not an important soil type, although where the topographic conditions are favorable it makes valuable farm land. In such locations it is well adapted to all the staple farm crops common to the region. The soil is often termed "droughty," but the success with which small grains, such as oats and buckwheat, are grown in normal years hardly justifies the use of this term. Corn and grain ripen under favorable climatic conditions. The soil is considered a good alfalfa soil, and the success had with this crop should encourage its more general use. The application of limestone may prove valuable in obtaining satisfactory stands of this legume. Every effort should be made to increase and maintain the organic-matter content of the soil.

Originally the type was covered with a dense gowth of white pine and hemlock. Nearly all of the type has been cleared, but some of the rougher areas are now reverting to forest.

PALMYRA GRAVELLY LOAM.

The Palmyra gravelly loam consists of about 8 inches of dark grayish brown to dark-brown, when moist, friable gravelly loam, with a moderate supply of organic matter, resting on a subsoil of yellowish-brown loose gravelly silt loam or loam, which extends to a depth of 3 feet or more. Lime carbonate occurs in the soil or subsoil, commonly in the latter. Gravel and stones in the substratum are coated with lime.

The entire 3-foot soil section consists of a well-oxidized, unassorted mass of fine earth material admixed with angular and rounded frag-

ments of shale, sandstone, limestone, and to less extent igneous rocks. The substratum appears at varying depths, but in most places where seen in exposures in road cuts or erosions it lies 4 or 5 feet below the surface. The material consists of stratified beds of brown to dark-brown sand and gravel, all well rounded and composed for the most part of the same kinds of rocks as appear in the overlying material. The substratum differs from the overlying soil-forming material, however, in being unoxidized and assorted. In places this stratum appears within the 3-foot section.

A characteristic feature of the Palmyra gravelly loam is the lack of assortment of the material in the 3-foot section. This feature also is noted in many soils in the county formed under similar conditions. It appears that weathering and alteration of the material, especially in the case of easily disintegrated shale fragments, have brought about an apparent heterogeneity, in a way resembling that found in glacial till, which did not exist in the material as laid down.

The type is rather variable in texture and in the percentage of gravel and stones found on the surface. On some of the more eroded areas the proportion of angular shale fragments is considerable and the type is in reality a stony gravelly loam. This condition is especially pronounced on Coy Glen delta, 2 miles west of the city of Ithaca. Other delta areas that have been subjected to considerable erosion show a similar variation.

The Palmyra gravelly loam has been formed by the post-glacial weathering and alteration of delta material laid down by swiftly flowing streams entering temporary glacial lakes. There are some exceptions to this general statement. Indeed, the charactersitics of the soils themselves are the most important factors in determining the soil series. Many areas of Chenango gravelly silt loam and also some areas of Wooster gravelly silt loam occupy positions which would suggest that they were formed under conditions similar to the Palmyra gravelly loam, but the depth of the surface soil, the arrangement of the material in the subsoil, and the composition of the soil-forming material serves to distinguish the different soils.

The topographic features of the type are variable. The delta material in its original position was characteristically flat, but few flat remnants of the original plains remain, owing to erosion and to the slumping of the stratified beds of sand and gravel. The delta material in many places occurs in a series of different levels, the front slopes of which are gentle to steep.

The surface drainage and underdrainage of the type are good. The type is not considered droughty, although some crops are likely to suffer from lack of moisture in seasons of abnormally low rainfall.

The soil type is not important agriculturally. Where it occurs in favorable topographic positions in sufficiently large units it is a desirable farming soil, but a comparatively small area of the type is mapped in Tompkins County.

PALMYRA GRAVELLY SILT LOAM.

The surface soil of the Palmyra gravelly silt loam consists of a grayish-brown to rather dark brown (when moist) friable, gravelly silt loam, with a depth of about 10 inches. The succeeding 8 inches constituting the upper subsoil is a grayish-brown to light-brown more

compact gravelly silt loam. The lower subsoil consists of stratified sand, gravel, and cobblestones. Lime is invariably found in the more compact upper subsoil layer. The content of organic matter is higher than in other soils of similar position.

The gravel found on the surface of the type is rather variable in composition. In most places shale and sandstone with some igneous rocks form the coarser surface material. With the exception of a small area of the type along Salmon Creek, near the Cayuga County line, no limestone is present on the surface over any considerable area. In most places the underlying beds contain a large percentage of limestone.

The Palmyra gravelly silt loam is developed in several of the larger valleys of the county. It occurs in close association with the Dunkirk and Groton soils, from which it has acquired a great part of its calcareous material.

The type is typically a terrace soil and is separated from the Genesee silt loam mainly on the basis of its position and character of soil profile. Separation from the Chenango gravelly silt loam is at times difficult, when only the lime factor is borne in mind. However, the darker color of the Palmyra type, together with the character of the soil-forming material, as influenced by adjacent soils, serves to distinguish the two.

The Palmyra gravelly silt loam is derived from the weathering and alteration of terrace material laid down by swiftly moving currents of streams active near the close and subsequent to the existence of the glacial lakes. It is considered that the soils in Tompkins County are related to the more recent drainage. It does not occur on broad outwash plains in this county, but is confined to relatively narrow strips between the adjacent calcareous Groton and Dunkirk soils. The influence of these surrounding soils is reflected in the character of the crops grown successfully on the type, the legumes in particular.

The topography of the type is flat. The areas along Salmon Creek are badly cut up by the meandering of that stream in its flood plain, and consequently the type does not commonly occur in large areas. Owing to the open, porous nature of the subsoil, the type is well drained.

Owing to the small extent of the type in the county, it can not be considered an important soil agriculturally. Where it occurs in large units, it makes very desirable farming land, being productive and adapted to a wide range of crops. General farm crops, including clover, alfalfa, corn, beans, oats, wheat, and vegetables, are grown.

The selling price of such land, where it occurs in large units, compares well with that of the best lands in the county.

CHENANGO STONY SILT LOAM.

The Chenango stony silt loam consists of 12 to 14 inches of yellowish-brown to grayish-brown (when dry) friable stony silt loam, underlain by a subsoil of grayish-brown gravelly silt loam or loam extending to a depth of 36 inches or more. The upper part of the subsoil horizon is slightly compact. Angular and rounded gravel and stones are thickly strewn on the surface, many shale fragments, 8 inches or more in length appearing in this coarse material. Rounded waterworn gravel is most abundant in the lower part of the 3-foot section.

The substratum consists of loose beds of gravel. The entire soil is devoid of lime carbonate.

The Chenango stony silt loam occurs in close association with the Chenango gravelly silt loam, from which it is distinguished by the large shale fragments present on the surface. It is not extensive, and the individual areas are small. The largest occurs in the extreme southwestern part of the county in Pony Hollow. Other areas are mapped 2 miles south of Enfield in Enfield Town and one-half mile north of Ellis in Dryden Town.

The type is derived for the most part through weathering and alteration of terrace material, modified by wash from the adjacent upland. The surface of the type is comparatively flat to only very gently sloping.

Both surface drainage and underdrainage are good, owing to the porous nature of the subsoil and substratum. The soil appears to be rather low in organic matter, and contains no lime carbonate, according to field tests with acid. It is developed in association with the Wooster, Lordstown, and Canfield soils of the upland and with the Chenango gravelly silt loam of the terraces, from which it does not differ materially in agricultural value.

CHENANGO GRAVELLY SILT LOAM.

The surface soil of the Chenango gravelly silt loam consists of brown to yellowish-brown friable silt loam or fine loam, about 10 inches deep. The upper subsoil is a grayish-brown or gray gritty silt loam somewhat heavier in texture but only slightly more compact than the surface soil, extending to a depth of about 16 inches. Below 16 inches and extending to a depth of 36 inches, the subsoil consists of pebbly or gravelly dark-brown coarse silt loam or loam. The material throughout the soil section is devoid of lime carbonate.

The soil has a moderate supply of organic matter, but contains less of this constituent than the Palmyra soils.

The Chenango gravelly silt loam is found well developed at Red Mill in Dryden Town, and in the neighborhood of Slaterville Springs, in Caroline Town. Quite a large area of the type is mapped along Buttermilk Creek, in Danby Town, and another area of considerable consequence, in Pony Hollow in the southwestern part of the county. Small, scattered tracts lie along many of the smaller streams in the county.

The topographic position of the Chenango gravelly silt loam indicates that the material has been accumulated in several different ways. The most extensive areas of the type have been formed from terrace and delta materials laid down at the ice front by swiftly moving waters at or about the close of the glacial epoch. The large area in Pony Hollow, in the southwestern part of the county, is outwash material, deposited by a glacial stream issuing from a terminal moraine of an ice tongue from the north. A similar deposit exists east of Slaterville Springs, in Caroline Town. At Danby, in Danby Town, the soil material giving rise to this type is correlated with the outwash gravels on the basis of arrangement and composition of the material rather than on any definite knowledge of the method of accumulation. It is hard to account for the presence of the Chenango gravelly

silt loam at this place. To the southeast of Danby, about 3½ miles, an area of the type occupies a typical outwash plain.

By another process of accumulation the material has been deposited by streams in bodies of water, giving rise to deltas. That some of the areas mapped as Chenango gravelly silt loam were formed under such conditions is undoubtedly true. However, such material, where well developed, has been mapped as soil of the Palmyra series, on the basis of the presence of lime in the soil section and the darker color of the surface soil. Where the Palmyra and the Chenango soils adjoin the line of demarcation naturally is difficult to determine. Especially is this true north of Brookton, in Caroline Town.

There are a few areas of Chenango gravelly silt loam in the county that represent stream terraces formed as a result of the normal development in the evolution of a stream. Such terraces exist along Cascadilla and Fall Creeks. The type also has been influenced by additions of material deposited by the streams emerging from the hillsides and forming alluvial fans.

The topography in general is flat to gently sloping; those areas composed of distinct outwash or delta material are usually flat, while other bodies of the type have the appearance of alluvial fans, in that they have a gentle slope toward the center of the valley. As a rule the drainage is thorough and in some instances excessive, especially where the substratum of gravel lies rather close to the surface.

The Chenango gravelly silt loam, although of small extent, is a valuable agricultural soil, and owing to its favorable surface features and ease of cultivation a large proportion of it has been cleared and put under cultivation. It is in condition for plowing or planting earlier in the spring than most of the other soils. The original forest growth was pine, hemlock, chestnut, maple, beech, and cherry.

The type is well adapted to the production of most of the staple crops grown in the county. Good yields of corn and wheat are obtained. Alfalfa apparently does well, notwithstanding the absence of lime carbonate in soil and subsoil.

As is the usual case with soils of like topographic position and ease of accessibility, these soils have been cropped extensively over a long period of years. Although the natural fertility of the type was great, this continuous cropping has in some cases resulted in decreased yields. Other than the most general recommendations as to the advisability of crop rotation and the judicial use of commercial fertilizers and lime, nothing as to soil management can be stated. Definite recommendations as to the fertilizer needs and crop requirements are very desirable, but these can be made only after data have been accumulated by experiment. The soil type is undoubtedly one of the most responsive to good treatment in the county.

GENESEE SILT LOAM.

The Genesee silt loam is a grayish-brown to dark grayish brown (when moist) friable silt loam to a depth of about 12 to 14 inches. The subsoil to 30 inches consists of a grayish-brown, slightly heavier, though friable, gritty silt loam. Below 30 inches the subsoil is in most places mottled with gray and rusty brown. Beds of sand form the substratum in most of the areas.

The Genesee silt loam is quite uniform in color and depth of soil material. It, however, varies somewhat in texture and in the pres-

ence of lime. Thus, at Nina, in Newfield Town, an area approximates a fine sandy loam in texture. The type here is calcareous throughout the entire section. It would appear that the fine sand deposited on the flood plain of the streams in this neighborhood is derived from the dark-colored calcareous sand which lies at the base of the glacial-lake deposits in the Inlet Valley, tributary to Cayuga Lake. The Genesee silt loam is not calcareous over the entire area of its distribution. East of Danby, in Danby Town, and along Cascadilla and Fall Creeks the soil material does not show the presence of lime. Indeed, wherever the type contains lime the soil material has come from lake-laid deposits. The type also contains less fine sand than typical in certain localities, and the result is a more compact and heavier soil. The Genesee silt loam is most extensively developed in the Inlet Valley south of the city of Ithaca, on the lower lying areas of the flat. The valley, whose floor is now occupied by this soil type, was formerly a lake. The process of deposition of soil material is still active at certain periods of the year. The smaller areas of the type in other parts of the county represent recent alluvial material. The soil here consists very largely of reworked shale and sandstone material washed from the uplands and is noncalcareous.

The topography of the Genesee silt loam is in general flat, though in areas along the smaller streams it might be slightly ridgy, as a result of the meandering of the streams and the presence of abandoned channels and other depressions. The drainage on the flat near Ithaca and down the inlet is very poor and improvement of the condition presents difficult problems. The whole surface lies so level that run-off is almost entirely lacking and no outlet which would be open throughout the year can be obtained for underdrains. The areas lying in narrow stream bottoms in various parts of the county are generally fairly well drained.

The original vegetation of the Genesee silt loam found on the valley flat was for the most part a luxuriant growth of wild grass. A few elms and oaks of immense size grew along the edges of the flat. Many areas of the type lying in the narrow bottoms of small streams now support a growth of elm, soft maple, sycamore, black ash, and other moisture-loving trees.

The Genesee silt loam in the Inlet Valley when well drained produces excellent crops. It is especially considered a good soil for truck crops. However, owing to the difficulty of drainage, the type is not extensively cultivated.

HOLLY SILTY CLAY LOAM.

The surface soil of the Holly silty clay loam consists of a bluish-gray to gray, slightly mottled with brown, friable silty clay loam, with a depth of 10 inches. The subsoil is a light yellowish gray or gray compact silty clay or clay mottled with brown and drab. The surface and subsoil material to a depth of 3 feet or more is uniformly free from gravel and stones. The material is noncalcareous.

This type varies considerably in color, depth of soil, and texture. In low, slightly depressed areas the color of the surface material to a depth of 2 or 3 inches tends toward a dark brown or brown like that of the Genesee silt loam, the typical gray color of the Holly appearing below. In other places, as on the flat south of Ithaca, the Holly silty clay loam contains some peat or muck in the subsoil at a depth of

about 24 inches. Here the type is found in close association with the Genesee silt loam and Meadow, from which it is very indistinctly separated at times. Southeast of Peruville, in Dryden Town, the surface soil is in places a dark grayish brown to dark-gray clay loam extending to a depth of 6 or 7 inches, the change to the gray, mottled silty clay subsoil being abrupt.

The Holly silty clay loam, like the associated Genesee silt loam, is of comparatively recent alluvial origin, and even now is undergoing the processes of formation. The type occupies an area of less than 3 square miles. It lies in scattered tracts along drainage ways and southeast of Peruville occupies an area resembling an old lake bed. Apparently the area along the county line near the village of Caroline is of similar character.

In general, the type occupies a low topographic position and has a flat surface. The natural drainage is consequently very poor, the areas including depressions that are filled with water, especially during wet seasons. Underdrainage is necessary before cultivated crops can be grown. In its undrained condition it affords some pasturage and in the drier places some hay.

Originally all the type was forested. The native vegetation now consists of swamp grasses, with some soft maple and elm trees. The agricultural use of the type is for permanent pasture and the production of hay.

ALLIS STONY SILT LOAM.

The surface soil of the Allis stony silt loam consists of about 5 inches of light brownish gray to dark-gray heavy silt loam to silty clay loam. The subsoil is a heavy, compact, highly mottled gray, yellow, and brown silt loam to silty clay loam. The mottled condition is most pronounced in the upper part of the subsoil. Where the soil material averages from 18 to 30 inches in depth, the lower part of the subsoil is grayer and less mottled, more resembling unmodified residual material. Bedrock consisting of shale lies from 10 to 30 inches below the surface, and shale fragments are scattered over the surface and throughout the soil material.

The Allis stony silt loam is found widely distributed on slopes and along draws leading from the crests of the hills. In this position the soil is easily recognized. The land is inclined to be seepy, and water in many places appears trickling down the hillsides. The roads are often spongy, and drainage conditions are altogether very unsatisfactory.

The Allis stony silt loam represents a thin till deposit, derived for the most part from the underlying country rock formations of shale and sandstone.

Owing to the position of the soil and the character of the subsoil, a concentration of soil moisture is brought about which results in a water-logged condition and consequent formation of the characteristic gray and yellow mottled subsoil.

The Allis stony silt loam in Tompkins County, with the exception of a few areas, is not desirable for farming. It is doubtful if there is any better way to use it than to allow it to revert to forest. A large proportion of the soil is now in forest, and originally it all supported a dense growth, mainly pine and hemlock.

The best agricultural use of the type is the production of hay, and even for that purpose only a small percentage of it can be used advantageously. On some of the more favorably situated areas buckwheat, oats, and potatoes are grown with fair success. The type is used largely for pasture in its present state.

The soil is one of the least productive in the county. The selling price is very low, usually not more than $10 an acre. The price depends upon many other factors, besides quality of soil, such as stand of forest, nearness to towns and lines of transportation, and accessibility to good roads.

MEADOW.

Meadow as mapped in Tompkins County includes low depressions on the upland and in the valleys, where the surface is for the most part covered with water or is in swampy condition throughout the year.

Several large areas of Meadow are mapped in the north-central part of the county, where they occupy flats or slight depressions in the ground moraine. A large area also is mapped in the Cayuga Inlet Valley. This represents a part of the old lake floor. Here springs and creeks from the surrounding uplands are continually contributing moisture to an already water-logged soil.

Meadow is variable in texture and composition throughout its occurrence; indeed, it represents a condition rather than a type of material. A few small areas somewhat resemble muck in composition, and if these had been of sufficient extent and of enough agricultural value they would have been mapped separately.

A few areas of Meadow in the upland have been cleared and are used for pasture. Very few attempts have been made to drain the upland areas, and in the valley area drainage is impracticable because of lack of suitable outlets.

ROUGH STONY AND BROKEN LAND.

Rough stony and broken land includes the narrow strips of steep and vertical shale cliffs occurring in the deep gorges formed by the active cutting of streams descending from the hanging valleys to the Cayuga Lake level, and hilly and strongly dissected upland areas, where in many places the horizontal beds of shale and sandstone outcrop. The soil, where any exists, is very shallow. The land is valued mainly for its forest products and for the grazing it affords. Its value for the latter purpose varies greatly.

SUMMARY.

Tompkins County is situated in the central part of New York. It comprises a land area of 476 square miles, or 304,640 acres. The range in elevation is from 381 feet to more than 2,000 feet above sea level. The northern part of the county is gently rolling, representing ground moraines, while the southern part is a roughly dissected hilly plateau. The valley areas are rolling, consisting largely of morainic material. A large alluvial flat occurs at the foot of Cayuga Lake. The drainage is moderately well to well established.

The early settlement of the county followed General Sullivan's expedition in the latter part of the eighteenth century. The county was organized as a separate unit in 1817. The census of 1920 gives the population of Tompkins County as 35,285, of which 51.8 per cent is classed as rural. Ithaca, the county seat, has a population of 17,004.

Transportation facilities are good, there being a number of railroads and main highways surfaced and in good condition. Rural delivery of mail and telephone service are available in the rural sections.

Climatic conditions are favorable for the growing and maturing of a variety of farm crops. The mean annual temperature is 46.9° F. The absolute range is from −22° F. to 102° F. The mean annual precipitation, 34.28 inches, is well distributed. The mean annual precipitation for the growing season is 17.13 inches. The normal growing season, or the frost-free period, is 157 days.

General farming and dairying are the principal agricultural industries. The principal crops are hay, oats, wheat, buckwheat, silage corn, and potatoes. Some cabbage and beans and other minor crops are grown. Tame grasses for hay occupy somewhat more than half the total acreage in crops.

Buildings and farm equipment are generally quite good, and the farmers appear to be doing fairly well. Land values in general range from $10 to more than $100 an acre, with some orchard land and vineyards of much higher value. The soils of Tompkins County are derived from glacial materials, for the most part till, with some influence from the underlying rock, but to considerable extent from similar glacial materials reworked by water and laid down in lakes, deltas, or terraces. Some more recent materials lie along the present stream courses. The soils derived from glacial till are included in the Lordstown, Volusia, Canfield, Wooster, Chippewa, Lyons, Ontario, and Lansing series.

The Lordstown soils represent a thin till deposit mainly from shale and sandstone and are noncalcareous. They are prevailingly light brown to yellowish in color and have little or no compactness in the subsoil. Drainage is good. The soils are best adapted to the production of hay, small grain, and potatoes.

The Volusia soils are prevailingly brownish gray to gray in color, and the subsoil is mottled gray, yellow, and brown. The most distinctive feature of the series is a compact layer, resembling hardpan, lying below the surface soil. Drainage is poor. The soils are low in organic matter and are noncalcareous. They are best suited to the production of hay, small grains, and potatoes and for use as pasture.

The Canfield soils are generally grayish brown to gray and underlain by a yellowish-brown rather friable upper subsoil and by more compact, mottled yellow, gray, and brown subsoil. Drainage is fair—better than on the Volusia, but not as good as on the Wooster. The Canfield soils are adapted to general farming.

The Wooster soils are grayish brown to brown in color and have little or no compactness in the subsoil. Drainage is good. Little or no limestone is found in these soils. The Wooster soils are adapted to quite a wide range of crops.

The Chippewa soils are dark gray to nearly black in color, and underlain by a mottled gray, yellow, and brown subsoil. They occupy depressions or swales where drainage is poor to deficient.

The series is closely associated with the Canfield and Volusia soils It is of value principally for pasture.

The Lyons soils have grayish-brown to nearly gray soils, with mottled lower subsoils. They are usually calcareous in the lower subsoil. The Lyons soils are the poorly drained equivalent of the Lansing series.

The Ontario series includes types with light-brown to brown soils and yellowish-brown subsoils. These soils are well drained and are prevailingly calcareous in the lower subsoil. In Tompkins County the series has a distinct morainic topography.

The Lansing soils are usually grayish brown to brown in color and underlain by a brown or light-brown slightly mottled subsoil. The lower subsoil usually is calcareous. Shale and sandstone, however, make up the larger part of the soil-forming material. The Lansing areas are fairly well drained. The soils are adapted to a wide range of crops. Alfalfa is grown more extensively on this soil than on any other in the county.

The soils derived from lake-laid sediments include the types of the Dunkirk and Granby series.

The Dunkirk soils are yellowish brown to grayish brown in color. They are normally calcareous in the lower subsoil. Owing to the peculiar structural properties of the Dunkirk soils they are not adapted to such a wide range of crops as the associated drift soils. The heavier types are recognized as hay and grain soils.

The Granby series comprises types with dark-brown to nearly black soils, resting upon yellow to white fine sand. The subsoil is prevailingly calcareous. The Granby soils are usually found in depressions and are of value principally for the pasturage they afford and for the production of hay.

Included in the group of soils derived from old terraces, delta deposits, kames, and eskers are the Groton, Palmyra, and Chenango series.

The Groton soils are light brown to yellowish brown, with a yellowish-brown loose and porous subsoil, resting upon beds of stratified stones and gravel. Limestone makes up a high percentage of the waterworn gravel. The topography of the Groton series is distinctive—that of kame-and-kettle deposits.

The types of the Palmyra series have brown to light-brown soils and a brown to yellowish-brown slightly compact subsoil. The soils occur on terraces along the streams and on deltas adjacent to the old glacial valleys. They are calcareous. The distinctive feature of the Palmyra is the fairly even topography. The drainage is good.

The Chenango series includes types with brown to yellowish-brown surface soils and a yellowish-brown subsoil. The substratum consists of stratified beds of sand and gravel. The soils are devoid of lime. The topography is flat.

Included in the group of recent alluvial soils are the types of the Genesee and Holly series.

The Genesee soils are brown to grayish brown and normally calcareous. The Holly series, the types in which have a gray soil and mottled gray and brown subsoil, is represented in Tompkins County by one type. The Holly soils are noncalcareous. Both the Genesee and Holly soils are subject to inundation with every overflow of their present drainage.

The soils derived mainly from decomposition of the underlying rock are represented by one series, the Allis series. The surface soils in this series are light gray to yellowish gray and underlain by gray mottled with brown subsoils. Bedrock occurs at depths of less than 3 feet. The material is noncalcareous. Drainage is deficient.

Two so-called miscellaneous soils are mapped—Meadow and Rough stony and broken land. Meadow represents a poorly drained soil condition, associated in this survey with upland types. Rough stony and broken land includes areas too broken and steep or rocky for farming.

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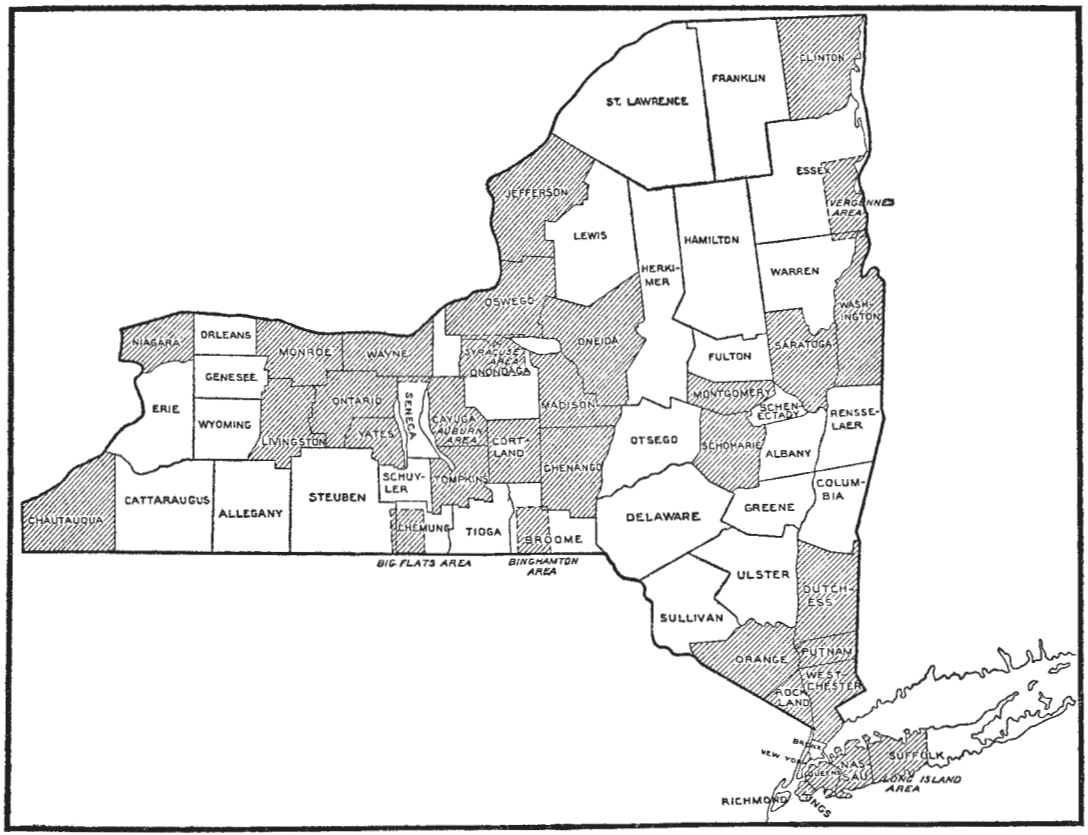

Areas surveyed in New York, shown by shading.

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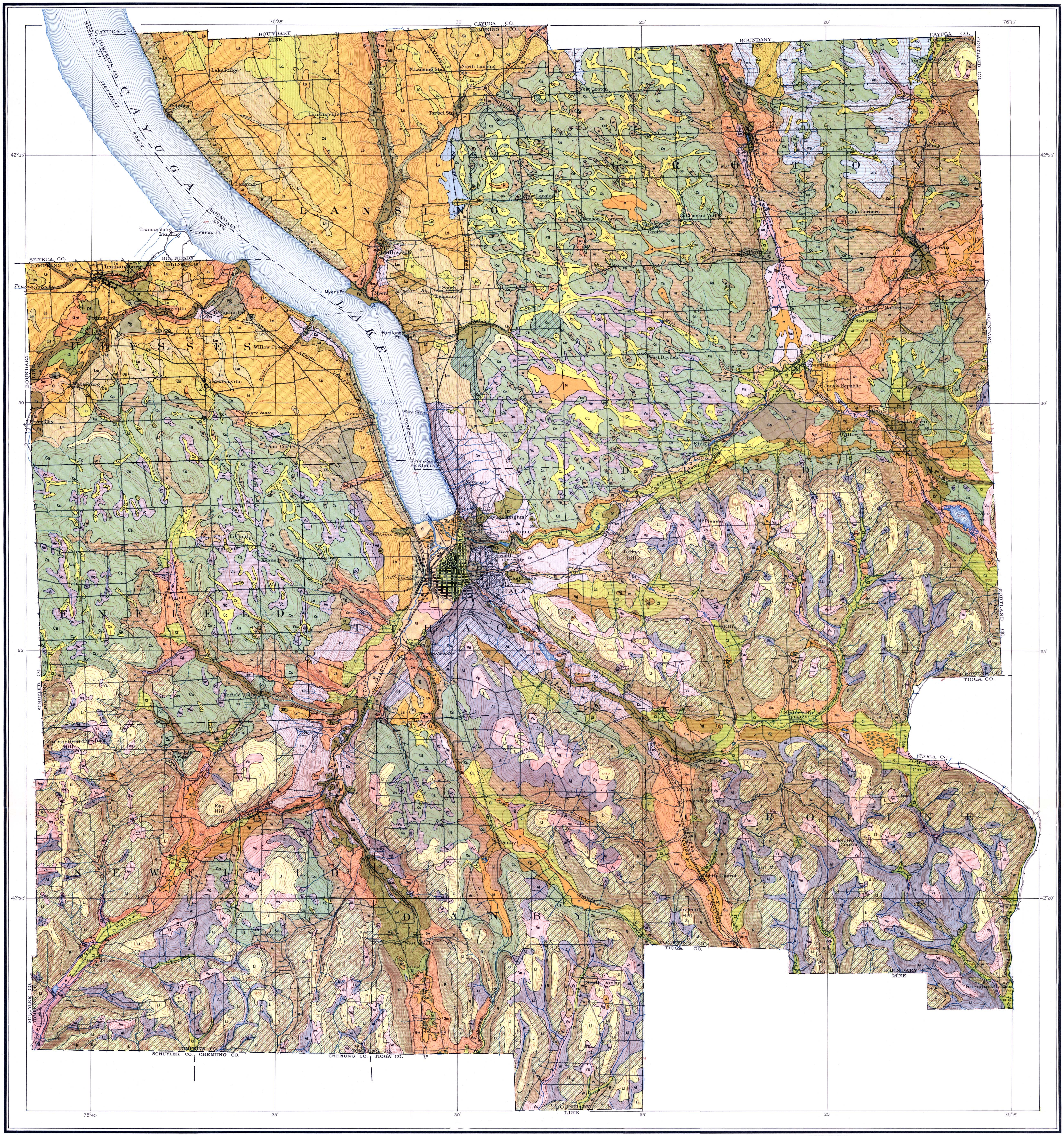
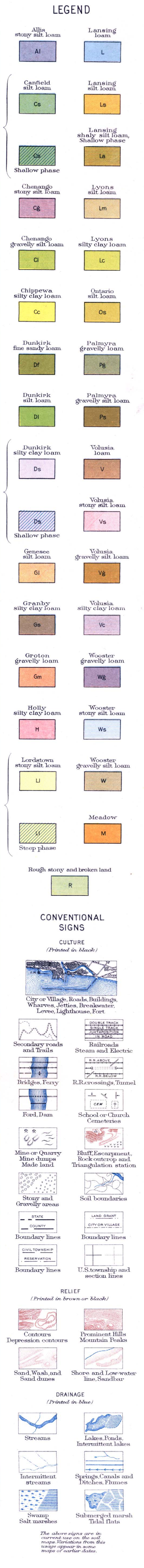
SOIL MAP

NEW YORK
TOMPKINS COUNTY SHEET





Soils surveyed by Frank B. Howe, in charge, and H. O. Buckman of the New York State College of Agriculture and H. G. Lewis of the U. S. Department of Agriculture.

BASE MAP FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale $\frac{1}{62500}$
1 ½ 0 1 2 3 4 Miles
1 ½ 0 1 2 3 4 5 Kilometers
Contour interval 20 feet.
Datum is mean sea level.

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Field Operations
Bureau of Soils
1920